THURSDAY, DECEMBER 16, 1875

## HAECKEL'S HISTORY OF CREATION

*The History of Creation.* From the German of Ernst Haeckel, Professor in the University of Jena; the translation revised by Prof. E. Ray Lankester, M.A., F.R.S., Fellow of Exeter College, Oxford. In two vols. crown 8vo, pp. 374, 401; 15 lithographic plates, woodcuts, and genealogical tables. (London: King and Co., 1876.)

HAVING in a review of Prof. Haeckel's "Anthropogenie" (see NATURE, vol. xi. pp. 4, 22) criticised both the manner and the substance of his popular lectures on Evolution, it is unnecessary to repeat what was then said. The "Schöpfungsgeschichte" is the earlier work of the two; it deals more with the general question of the evolution of the Organic Kingdom and less with its special application to Man; its tone is somewhat more moderate, and its statements and plates are less highly coloured. But the object and the style of both books are essentially the same, and they will be praised or condemned together.

Even in the short time since the delivery of the present lectures several points have been established which necessitate a modification of the views here expressed. The origin of the urino-genital organs has been proved in the classes as yet completely examined to be from the middle layer of the embryo; the embryology of Amphioxys and of Mollusca has been elucidated—by none more than by the editor of this translation; the placental classification of Mammalia, never accepted by all zoologists, has been almost reduced to the same rank as Waterhouse and Owen's cerebral system; the true nature of Lichens has been cleared up, and relations between Algæ and Fungi have been established which disturb the roots of the genealogical tree on Plate V. Moreover, Dr. Dohrn's bold speculations lately published in his pamphlet "Der Ursprung der Wirbelthiere und das Princip des Functionwechsels," have brought the question of degradation of many lower forms as well as of the genetic relations of Vertebrata into a new phase. It is remarkable how little the previously well-known instances of "degraded forms" are considered in these lectures. Surely some of the numerous twigs of the fifth, sixth, and fourteenth plates might have been turned downwards.

But whatever may be thought of the advantage of exhibiting together established truths and more or less erroneous speculations, in a dogmatic and controversial form, before an uncritical audience, there is no question of the value of these lectures to naturalists. They awaken thought, provoke criticism, and stimulate inquiry.

Turning from the subject-matter to the translation, we must call it an exceedingly good one. No one who has not tried knows the difficulty of presenting a continuous work in a foreign language to an English reader so as to drop the idiom and yet retain its character. If a page of the body of the work be compared with Prof. Haeckel's own preface—written in very good English, but as a foreigner writes—the reader will see at once how much he is indebted to the lady who, we are told, made the first draft, or to Mr. Lankester, who revised it.

The following passage is a fair specimen of the book:—

"Of the twelve species of men distinguished in the following table [namely Papuan, Hottentot, Caffre, Negro, Australian, Malay, Mongolian, Arctic, American, Dravidan, Nubian, Mediterraneanese, beside hybrids], the four lower species are characterised by the woolly nature of the hair of their heads; every hair is flattened like a tape, and thus its section is oval. These four species of woolly-haired men (*Ulotrichi*) we may reduce into two groups, 'tuft-haired' and 'fleecy-haired.' The hair on the head of tuft-haired men (*Lophocomi*), Papuans and Hottentots, grows in unequally divided tufts. The woolly hair of fleecy-haired men (*Eriocomi*) on the other hand, in Caffres and Negroes, grows equally all over the skin of the head. All *Ulotrichi*, or woolly-haired men, have slanting teeth, and long heads, and the colour of their skin, hair, and eyes, is always very dark. All are inhabitants of the Southern Hemisphere: it is only in Africa that they come north of the equator. They are, on the whole, at a much lower stage of development, and more like apes than most of the *Lissotrichi*, or straight-haired men. The *Ulotrichi* are incapable of a true inner culture and of a higher mental development, even under the favourable conditions of adaptation now offered to them in the United States of North America. No woolly-haired nation has ever had an important history.

"In the eight higher races of men which we comprise as straight-haired (*Lissotrichi*), the hair of the head is never actually woolly, although it is very much frizzled in some individuals. Every separate hair is cylindrical (not like a tape), and hence its section is circular (not oval).

"The eight races of *Lissotrichi* may likewise be divided into two groups—stiff-haired and curly-haired. Stiff-haired men (*Euthycomi*), the hair of whose heads is quite smooth and straight, and not frizzled, include Australians, Malays, Mongolians, Arctic tribes, and Americans. Curly-haired men, on the other hand, the hair of whose heads is more or less curly, and in whom the beard is more developed than in all other species, include the Dravidas, Nubians, and Mediterranean races."

The Caucasian, or to adopt Fr. Müller's less recognised name, the Mediterranean race, is divided into four subraces by the aid of language: these are (1) the Caucasians proper of Georgia and the surrounding mountainous district; (2) the Basques; (3) the Semitic nations, including not only the Arabs and Jews (*Eusemites*), but also the Hamitic or "Dyssemitic" Egyptians and Berbers, with some other African tribes; (4) the great Indo-Germanic or Aryan race, including Indo-Persians, Greeks, Italians and Kelts, Sclavonians and Teutons. The following passage concludes the chapter:—

"The third and most important main branch of primæval Malays, the curly-haired races or *Euplocomi*, have probably left in the Dravidas of Hindostan and Ceylon that species of man which differs least from the common primary form of the *Euplocomi*. The principal portion of the latter, namely, the Mediterranean species, migrated from their primæval home (Hindostan?) westwards, and peopled the shores of the Mediterranean, South-Western Asia, North Africa, and Europe. The Nubians in the north-east of Africa must perhaps be regarded as an offshoot of the primæval Semitic tribes who migrated far across Central Africa almost to the western shores.

"The various branches of the Indo-Germanic race have deviated furthest from the common primary form of ape-like men. During classic antiquity and the middle ages, the Romanic branch (the Græco-Italo-Keltic group), one of the two main branches of the Indo-Germanic species, outstripped all other branches in the career of civilisation; but at present the same position is occupied by the Germanic. Its chief representatives are the

English and Germans, who are in the present age laying the foundation for a new period of higher mental development in the recognition and completion of the theory of descent. The recognition of the theory of development and the monistic philosophy based upon it, forms the best criterion for the degree of man's mental development."

A noteworthy feature in the present translation is the attempt Mr. Lankester has made to use English equivalents for the technical terms of anatomy and zoology. The facility with which Prof. Haeckel invents terms, and the habitual use in German of vernacular phrases in scientific writing, made this a good opportunity for trying an experiment which the translator has before now recommended. The result shows great ingenuity and good judgment, and is probably as successful as the conditions of the attempt allow.

It will be generally admitted that the English language is incomparably richer and more flexible than the French, while it lacks the precision and neatness which with ordinary French writers is apt to become too mechanical and uniform, but in the hands of a master produces the most perfect instrument for scientific exposition. On the other hand, German is far more cumbersome and undisciplined than English, but has a slovenly ease, a picturesque force and a power of adaptation and word-making, which reminds one of our own language in the first half of the seventeenth century.

A French scientific writer cannot make a new term or form a compound in his own language, but must construct a Greek compound (often ill-formed), and even this must be modified so as to assimilate it to French pronunciation. And comparing the style of Bichat and of Cuvier with that of contemporary writers, we see that the stiffness and severity of the language has increased during the present century. Germans, on the other hand, can invent compounds without limit in number or in length, and can introduce foreign terms as they are wanted, even declining them in accordance with the German prepositions against which they are thrown.

The English language has much less power of forming compounds, though poets like Tennyson and Morris show us how flexible it becomes in powerful hands; but it has a remarkable capacity for assimilating foreign words. The unequalled richness of the language chiefly depends on its having so many synonyms, and this again on its composite character. The choice of words like friendship, amity; righteous, just; begin, commence; wax, increase; weariness, fatigue; spue, vomit; raise, erect; fruitful, fertile, gives peculiar accuracy, character, and delicacy to modern English.

If purely English words were to be generally adopted in science, we should, in the first place, be obliged to shock modern decorum in a way that would be practically impossible. Germans still write of *Kothentleerung*, *Wollustorgane*, *Afterbildung*; but such plainness of speech would be intolerable in English. Even such words as sweat, spue, spit are much better kept for rhetoric and poetry than used as physiological terms.

Moreover, our purely English names are too popular to be tied down to technical definition. The word "worm," for instance, applied by Milton to the serpent, and universally to the larva of diptera, can never be limited to correspond with the class Vermes. The objection that English terminology is not "scientific" can only mean that it is not scientifically accurate. To make it so would injure it for every other purpose.

Surely it is better to speak of the *ophidian* character of a vertebra than to call it "serpentine" or "snake-like." The first word refers to the anatomical distinctions of the class Ophidia, the second to the peculiar, lateral, wriggling locomotion of these animals, and the last to their supposed mental characteristics. In the same way *avian* is a better scientific term than "bird-like,"* *mammalian* than "beastly," and *piscine* than "fishy;" because those are at once recognised as referring to the technical characters of the classes Aves, Mammalia, and Pisces respectively, while these suggest far more vividly the special peculiarities which common observation associates with them.

It must however be admitted that a vernacular synonym is often of value. It brings an unobvious fact vividly and clearly before one. Thus the phrases, "a fox is a kind of dog," "a tiger is only a large cat," "the sword-fish is a sort of mackerel," are certainly more easily remembered than corresponding statements in "scientific" language.

The simplicity and directness of idiomatic English is often an advantage as a matter of style.

For teaching botany to children, and generally for explaining scientific facts to persons unfamiliar with technical names, it is often desirable to use vernacular terms, either to avoid disgusting them with hard words to begin with, or to fix the attention on facts rather than names and prevent the learner supposing that he has made a step in knowledge when he has learned to call hardness impenetrability, or a buttercup Ranunculus.

Lastly, for the probably increasing number of persons who study science without having learnt Greek, it is of great importance that even when using technical names they shall know the English synonym as a kind of ready translation. When everyone wrote in Latin many terms which are now become technical were simply descriptive. Thus "the passage from the third to the fourth ventricle of the brain" was certainly never meant to be a proper name, nor was "the waterpipe of Sylvius:" but now when "iter," "aquæduct," "tympanum," "cilium," have become restricted to single objects, it is well that their meaning should be readily apprehended by the use of appropriate English synonyms. At all events the attempt was worth making, and we will conclude this notice by giving a list of some of the synonyms used by Mr. Lankester.

| | | |
|---|---|---|
| Cotyledon | = | Seed-lobe or germ-leaf. |
| Nucleus | = | Kernel. |
| Nucleolus | = | Kernel-speck. |
| Cytod (surely this should be cythode). | | |
| Catallacta | = | Flimmer balls. |
| Labyrinthuleæ | = | Tramweavers. |
| Diatomaceæ | = | Flintcells. |
| Rhizopoda | = | Raystreamers or Rootfeet. |
| Algæ | = | Tangles or waterweeds. |
| Labiatæ | = | Lipblossoms. |
| Gamopetalæ | = | Bell-flowers. |
| Ctenophora | = | Combjellies. |
| Lamellibranchiata | = | Mussels. |
| Gasteropoda | = | Snails |
| Crustacea | = | Crabfish. |

* The prettily invented word "unbirdly" occurs in Cowley's fine Ode on Liberty—

"Even to the universal tyrant love
You homage pay but once a year,
None so degenerous and unbirdly prove
As his perpetual yoke to bear."

| | |
|---|---|
| Sagitta | = Arrowworm. |
| Tunicata | = Sea-sacs, including sea-squirts (*Phallusia*), and sea-barrels (*Salpa*). |
| Chitonidæ | = Beetle-snails. |
| Tetrabranchiata | = Chamber-poulps. |
| Pycnogonida | = Nobody-crabs. |
| Arthropoda | = Insects. |
| Insecta | = Flies. |
| Phocidæ | = Sea-dogs. |
| Sirenia | = Sea-cows. (This order is allowed to remain in unnatural alliance with Cetacea.) |

We have noticed a few verbal errors, such as "cetae" for "cete," "coecum" for "caecum," two misprints on p. 308, and an unlucky form of the name of an African tribe on p. 330.

The plates are excellently reproduced, and the print, paper and index show the care with which these two volumes have been prepared. P. H. P. S.

## BURTON'S GORILLA LAND AND THE CONGO

*Two Trips to Gorilla Land and the Cataracts of the Congo.* By Richard F. Burton. Two vols. (London: Sampson Low and Co., 1876.)

THE journeys here recorded were made so long ago as 1862 and 1863. Since that time Capt. Burton has not been idle; between exploring and publishing the results of his explorations he has sufficient excuse for having kept from the public for so long the narrative of his trips to the Gaboon and the Congo. Moreover, as he says himself, Africa moves so slowly, that ten years makes scarcely any appreciable change on a locality. The publication of the work at the present time is opportune, as public attention is being directed to the region with which it is concerned; the German African Society have taken up the Congo district as a *point de départ* for the interior, and although the expedition sent out has not been so successful as might be wished, still Dr. Pogge and Dr. Lasaulx, according to the latest news, are endeavouring to push inwards from Loanda. There have been several explorers on the same ground since Capt. Burton visited it twelve years ago, and there have been many previous explorers—the stretch of coast included in the two narratives contains some of the earliest Portuguese settlements; but as was shown in his recently-published book on Iceland, this widely experienced traveller and keen observer can shed new and unexpected light even on the most frequently trodden paths. The present work will be found a substantial contribution to our knowledge of the Gaboon and Congo districts, especially in the matters of geography, topography, and people.

Capt. Burton's visit to the Gaboon extended over only a few weeks in March and April 1862, but during that time, his first volume shows, he managed to see and to learn much. He is nothing if not unflinchingly true to his opinions, and these, as usual, he expresses freely and without respect of persons throughout the two volumes. He gives rather an unpleasant picture of the character and condition of the French trading establishments on the Gaboon, and indeed has not much praise to bestow on any of the establishments, French, Portuguese, or English, which he has occasion to mention in his work. Capt. Burton's chief object in visiting the Gaboon was to obtain some specimens of Gorilla, and, if possible, get a young one alive. He did not, however, get a shot at one during all the time of his visit; but a fine specimen was sent him by a native before he left, which, in a sadly deteriorated condition, now rests in the British Museum.

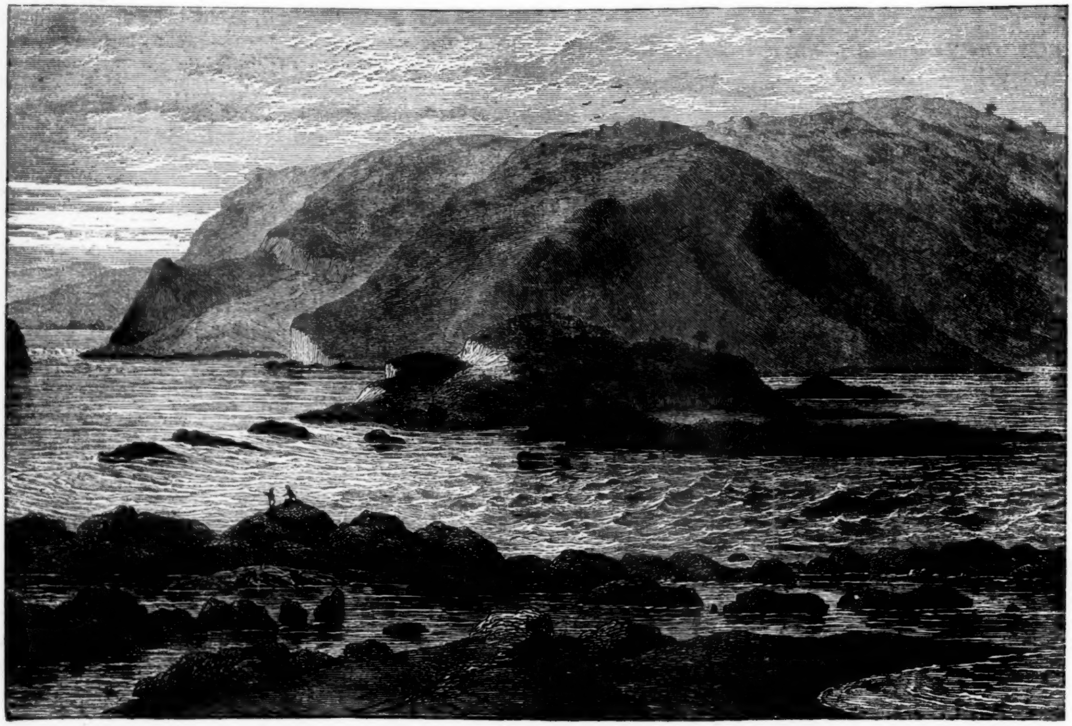
The traveller made a trip in pursuit of "our big brother," as he calls the animal, to the south side of the river, and gives some very graphic pictures of the degraded natives who inhabit the many villages of the district. His remarks on the customs of the people, the Mpongwe, as they are called, especially their marriage and religious customs, are extremely interesting. This chapter is interspersed with many shrewd philosophical remarks, in Capt. Burton's well-known style, on human customs generally, and shows extensive knowledge derived both from reading and experience. What he says upon the curious resemblance between certain customs among the Mpongwe and other West-Coast tribes, and the religious rites of the Jews, seems to us of real value. He also refers to what has been done to obtain a knowledge of the language of these people. His lively description of the troubles he had with the slippery and lazy natives in seeking the Gorilla will be found very amusing. With reference to the habits of the Gorilla, Burton substantially confirms the statements of Du Chaillu, though in some few points the matter-of-fact Englishman shows that the Frenchman had given way to exaggeration; *e.g.*, in the matter of the elaborately-constructed canopied nest or hut, Capt. Burton thinks Du Chaillu must have been deceived by some vagary of nature. The natives ridiculed the idea, and all that Capt. Burton saw were heaps of dried sticks built in forks of trees, and which a schoolboy might have taken for birds' nests. One entire chapter is devoted to "Mr., Mrs., and Master Gorilla," in which are discussed the results of his own and of other observations. It includes a historical account of references to the Gorilla, from Hanno the Carthaginian, downwards; the geographical limits of the animal are pointed out, as well as the modifications which ought to be made in Du Chaillu's account.

Capt. Burton made a trip down the coast for a few miles and another up the river to the Fan (Fa*n* he spells it, to indicate that the *n* is strongly nasalized cannibals; but the existence of cannibalism, in the ordinary sense of the term, seems doubtful. They do roast and eat portions of their enemies slain in battle, but this evidently is regarded as a quasi-religious rite. As might be expected, Capt. Burton indulges in a brief dissertation on anthropophagy in general, bringing to bear upon it much knowledge of the customs of peoples in various parts of the world. With regard to the Fans, Du Chaillu's account led him to expect to see "a large-limbed, black-skinned, ferocious-looking race, with huge mustachios and plaited beards. A finely-made, light-coloured people, of regular features and decidedly mild aspect, met my sight." On the whole, the Fans seem to be a very fair specimen of savage man. Capt. Burton gives details concerning the various tribes at the head and to the east of the Gaboon, about whom little or nothing is as yet known, and points out the suitability of the river as a *point de départ* for exploration in Inner Africa. One chapter is devoted to the geography of the Gaboon region. On the voyage back Capt. Burton visited Corisco Island in the bay of that name, about which and the missionaries

upon it he gives some interesting details. A good map of the coast districts for two degrees on each side of the equator accompanies the first volume.

The second volume refers to a visit made in July–September, 1863, to the Congo and the Portuguese settlements on the adjoining coast. Concerning these settlements many valuable and curious facts are given throughout the volume, both historical and as the result of the traveller's own observation at the colony of Loanda. Capt. Burton notes a considerable improvement in the morals and manners of the settlers as compared with previous accounts. The picture of the English establishments at Loango is not a very bright one. He paid a visit to Calumbo on the Cuanza or Quanza river, and mentally noted an exploration eastwards which he purposed to make in the future, but which he is glad to see has been taken up by Capt. von Homeyer. Ambriz to the north of Loanda was visited, and a short trip inland was made, during which, of course, many notes are made on the character and customs of the people. Ambriz has recently come to the front in connection with the German African expedition.

The chief interest of the second volume is connected with the Congo river, up which Burton journeyed as far as the Yellala, or rapids, which he calculates to be between 116 and 117 miles from the mouth, the total fall in that distance being 390 feet, of which 195 feet occurs between the Yellala and Boma, 64 miles. From the Great Rapids to the Vivi or lowest rapids, a distance of five miles, the fall is 100 feet. Some important facts are given as



The Yellala (rapids) of the Congo River.

to the character of the Congo mouth and the changes which are constantly taking place, which must even yet be of value to chart constructors. Considerable details are also given concerning the delta or series of islands at the mouth of the Congo, and a chapter is devoted to the explorations of previous travellers. An amusing account is given of his interview with the native king at Banza Chisalla, a few miles above Boma, and in this connection an attempt is made to account for the fondness for what seems to us a most ridiculous dress on the part of African and other savage potentates. The author gives a minute and graphic description of the river and its many reaches between Boma and the rapids; the scenery on the banks is often quite Rhine-like in its character. The river itself Capt. Burton regards as one of the noblest in the world. With a valley area of 800,000 square miles, it has a yearly mean volume of 2,500,000 cubic feet per second, nearly four times that of the Mississippi, which has a very much larger drainage area. In this connection some interesting data are introduced concerning the four great African arteries, the Nile, the Niger, the Zambeze, and the Congo or Nzadi, as Capt. Burton makes the true native name to be. In the chapter, "Notes on the Congo River," which contains the summary of the explorations of previous travellers, Capt. Burton discusses the probable

connection of the Congo with the water system of Central Africa. This chapter altogether is one of the most valuable in the book.

On his way to the rapids he was detained for some time at the village Banza Nokki, near one of the upper reaches of the river, and of course took the opportunity of studying the people, who seem to have been but little affected by the labours of the Portuguese missionaries who lived among them for so many generations. The district Burton describes as a perfect paradise, the country lovely, and the climate all that can be desired. Very full details are given as to the ways of life of the people, their various customs, their superstitions, their language, &c. After the usual vexatious delays, Capt. Burton was able at last to set out on Sept. 16 for the cataracts of the Congo. These and their surroundings, the character of the country on the river banks and of the people dwelling near, are described in his usual graphic style, and with consider-

Fetish boy (Congo district), showing dress during the novitiate at puberty.

able minuteness. He had hoped to be able to push on as far as Nsundi, upwards of 100 miles beyond the Yellala, but the difficulties thrown in his way by the chiefs on whose expensive favour he was dependent, compelled him to return. In a chapter on "The Slaver and the Missionary on the Congo River," he records opinions which are well deserving the attention of all who not only wish well to the native African, but who desire that the best means be taken for developing the immense resources of that continent, and of tropical countries generally. He concludes "with the hope that the great Nzadi, one of the noblest and still the least known of the four principal African arteries, will no longer be permitted to flow through the White Blot, a region unexplored and blank to geography as at the time of its creation, and that my labours may contribute something, however small, to clear the way for the more fortunate explorer." There can be no doubt that his labours, short as his time was, have added materially to our knowledge of the region visited, and his work must henceforth be regarded as one of the chief authorities, not only on the river and its geography, but on its people, and to a considerable extent its natural history and meteorology. Like all Capt. Burton's narratives, it is complete and comprehensive, and includes far more than the mere title would lead us to expect; it cannot fail to greatly interest and instruct every intelligent reader.

An excellent chart of the river from the sea to the rapids accompanies the second volume, and the illustrations to both volumes add to its value and interest. Appended are some meteorological data, a list of plants collected in the Congo, at Dahome, and the island of Annabom, and a list of heights of stations on the Congo computed from observations made by Capt. Burton.

## THE GERMAN NORTH SEA COMMISSION

*Jahresbericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel für die Jahre* 1872, 1873. Im Auftrage des Königlich Preussischen Ministeriums für die landwirthschaftlichen Angelegenheiten, herausgegeben von Dr. H. A. Meyer, Dr. K. Möbius, Dr. G. Karsten, Dr. V. Hensen, Dr. C. Kupffer. 1 Abtheilung. (Berlin, 1875.)

THE Prussian Minister of Agriculture has just published Part I. of the Report of the Commission appointed to inquire into the scientific conditions of the German Ocean at Kiel (for the years 1872, 1873). This Report forms a very important document, filling a small folio volume of 170 pages, with 12 plates and a chart. The editors are Drs. H. A. Meyer, K. Möbius, G. Karsten, V. Hensen, and C. Kupffer. The Report on the currents, temperature, and specific gravity of the sea-water, based on 255 observations made from July 21 to Sept. 9, 1872, is by Dr. H. A. Meyer, and to it there is appended a memoir "On the Air in Sea-water," by Prof. Dr. Oscar Jacobsen. The marine flora of the district is reported on by Drs. Magnus and Schmidt. The only Phanerogams met with were *Zostera marina* and *Z. nana*, and *Potamogeton pectinatus*. Of Algæ, excluding the Diatoms, 116 species are recorded. Of these, *Callithamnion membranaceum* and *Chytridium tumefaciens* are described by Dr. Magnus as new species; the former was found growing over the stems of *Sertularia abietina*, between Sprogoe and Corsoer, in from twenty to thirty fathoms, the latter protruding from the cells of *Ceramium flabelligerum;* these new species are well illustrated in two plates. The presence of claspers is noticed in *Plocamium coccineum* intertwining between Annelid tubes. *Hildebrandtia rosea*, Kütz., is held to be quite a distinct form from *H. rubra*, Meneg., though by Harvey it and *H. sanguinea*, Kütz., were all regarded as one and the same thing. *Hapalidium confervicola*, Kütz., is recorded, but nothing added to clear up our ignorance of this curious little alga. *Bonnemaisonia asparagoides*, Ag., was found bearing both Conceptacles and Antheridia on the same stem. *Myrionema orbiculare*, J. Ag., is the name given with much doubt to a form found very common on the sea-grass. The plant is not figured, but appears to differ from any known species of Myrionema: if proved to be generically distinct, the author proposes the name Ascocylus for a genus to receive it. *Chytridium tumefaciens* is described as a new species, growing on the root-hairs and stem-cells of *Ceramium flabelligerum*, taken near Edinburgh. In the description of this species and in the

details given about *Ch. plumulæ*, Cohn, the interesting question turns up as to what these Chytridia really are. Magnus treats them as a family of Algæ; Henfrey always, we believe, regarded them rather as the products of diseased protoplasm, if not modifications of the antheridial structures of some of the Confervoids. Their apparently common occurrence on Florideæ as well as on Confervoids, ought to enable this question to be definitely answered. Magnus is satisfied that the so-called Antheridea of *Callithamnion dispar* figured by Harvey in Tab. 227 of the "Phycologia Australica," are only Chytridia; certainly the figures represent a very antheridium-like structure, and the original dried specimen from which the figure was drawn is marked "fruit of an abnormal character," and on examination proves rather to favour Magnus's view.

Algologists, especially those engaged with the description of marine Algæ, have been rather neglectful of describing the minute details to be met with in the structure of the cells of Algæ. The arrangement of the cells, *inter se*, is necessarily studied, as on it the classification of the group depends; but the appearance and arrangement of the cell-contents will, we think, prove to be of as much importance in the investigation of the marine Algæ as it has proved to be in that of the unicellular freshwater forms.

Adolf Schmidt, of Aschersleben, describes the Diatomaceæ met with; there are three plates representing 134 forms or portions thereof. These are apparently photographs from drawings of the author.

The zoological results are given in eleven memoirs, with eight plates.

F. E. Schulze describes the Rhizopods and Cœlenterata; O. Schmidt the Sponges; K. Möbius and Bütschli the Echinoderms; K. Möbius the Vermes and Copepods; Kirchenpauer is to describe the Bryozoa, C. Kupffer the Tunicata, Metzger and H. A. Meyer the Mollusca, Metzger the Crustacea, and Möbius and Heincke the Fishes.

A long list of Foraminifera is given. H. B. Brady's papers on the synonymy of this group do not appear to have been consulted; an apparently new species of Gromia, about 8mm. in length, is described and figured. Some minute and doubtful-looking forms are described and figured as *Psammosphæra fusca*, n. g. et sp., *Stortho-sphæra albida*, n. g. et sp., and *Asterodiscus arenaceus* n. g. et sp.

Several new genera and species of Sponges are described and figured by O. Schmidt.

Among the Cœlenterates a new species of Aglaophenia (*A. moebii*) is figured and described, and *Kophobelemnon Leuckartii* is figured from a perfectly fresh specimen.

No very rare species among the Echinoderms is catalogued, and some common forms are absent.

Of the Vermes, seventy-six species of Annelida, fourteen of Turbellarea, five of Gephyrea, two of Chætognatha, and one Leech are enumerated. Although some of the species were collected off the very shores of Scotland, yet MacIntosh's works on the British Nemertians seem to have been overlooked in the determination of the species. A remarkable new form near Phascolosoma is described as *Crystallophrison nitens*. Almost the whole body is thickly encircled with colourless shining scales. The scales are somewhat wedge-shaped, with the narrow edge imbedded in the skin. This new species was dredged off the Silver Pit on the edge of the Dogger Bank. Further investigation may cause this species to be relegated to the Echinoderms. Three new species of worms are described.

The Second Part, containing the remaining orders, has just been published, and shall be reviewed in a second notice. To the British naturalists these Reports will be most valuable, but their form of publication may cause them to be easily overlooked; we have therefore noticed them somewhat in detail.

E. P. W.

## OUR BOOK SHELF

*The Origin of the Sun's Heat and the Chemical Constitution of the Matter of his System.* (Troy, N.Y., 1875.)

THE author's name does not appear on the title-page of this pamphlet, so that it was not till we had inflicted ourselves with its contents that we discovered at the end the signature William Coutie. The author, judging from the present production, is referable to that class of visionary speculators which includes among its numbers circle-squarers, seekers for perpetual motion, and those who perform what we may call arithmetical juggles with the atomic weights of the chemical elements. First comes a preface containing an extract from Priestley's narrative of the discovery of oxygen to which we shall again refer; after which follows a page headed "From the Acid Relations of the Elements" 1871, from which we select the two first paragraphs:—"I have now examined all the well-known elements with so much care that I cannot believe any general mistake possible, and find they are all compounds of hydrogen and three others whose weights are exact multiples of the weight of hydrogen. It is probable, therefore, they are all hydrogen; but before saying more I would request the aid of your skill in proving the above by experiment or the favour of your remarks so that I may correct errors or make the subject more clear or complete." We now lay before our readers the state in which Mr. Coutie leaves the question of the origin of the sun's heat. After demonstrating to his own satisfaction that none of the existing hypotheses are sufficient to account for this supply of heat, the author makes a series of statements leading up to the following conclusion, which must be allowed to speak for itself:—"As the energy of the earth in its orbit is 26,900 miles, and the reversing force of gravity in a year is four times greater, or 107,600 miles, and the energy required to melt ice $142\frac{1}{2}^\circ \times 772$ feet = 20 miles, the reversing of its motion by gravity, if converted into heat, would melt the weight of itself of ice 5,380 times a year, and would melt a mass of ice equal to the mass of the sun in 60 years, or in the same time the whole known heat of the sun would. But if the sun's heat is the direct result of this action, the total heat of the sun ought not to be the equivalent of the reversed energy of the earth, but ought to be the equivalent of the whole system; but it is the equivalent of the earth's energy in orbit. We have therefore found what we sought for, and, as usual in such cases, it is not as we expected, and if we had hit it exactly, we would have found ourselves as far as ever from the end of that chain which stretches across infinity. We therefore withdraw our surmises and leave it as it is to the labours of others." The next section treats of "the nature and relations of the chemical elements," the research (?) which has led to the results announced having been undertaken because the atmosphere of the earth mainly consisting of nitrogen the author determined to find out what nitrogen was "with a view of finding the process by which the system is formed." It is probably out of respect for

his reader's feelings that the author does not at once disclose the astounding discovery which is to revolutionise chemical science, but leads the imagination gently up to it—first informing us that he has spent his life in trying to practise the precepts of Newton and Watt—then indulging in a series of disparaging remarks on modern chemical theory, which remarks we may state *en passant*, perfectly bristle with mis-statements. The discovery which we are now approaching is, we are told, the result of an attempt to apply mechanical principles to chemistry—then the author lets us into a *trait* of his personal character, after which comes the *dénouement*. Here it is: "What I claim is the discovery of an element whose weight is 5; it combines directly with nitrogen, and forms fluorine, chlorine, bromine, and iodine; with carbon, and forms oxygen and sillicon (*sic.*); and with hydrogen and forms sulphur and lithium." This extraordinary and pantogenic element "is best described as being the opposite of hydrogen," which "opposition constitutes its energy, and this energy constitutes, or rather will constitute the science of chemistry. Its combinations, direct and indirect, with hydrogen, carbon, and nitrogen, form all the other elements except phosphorus." In the new chemistry potassium is "ammonia acid," sodium, "ammonium acid," lithium, and sulphur, "hydrogen acids," &c. We find no evidence in the pamphlet of the method employed in discovering the new element—before listening to Mr. Coutie's vague speculations, chemists will be justified in calling upon him to produce his *Pantogen*, and describe its properties—at present it exists only on paper. We may appropriately conclude this notice with a quotation from Priestley, printed by the author in the preface to the present rhapsody. "For my own part I will frankly acknowledge that at the commencement of the experiments recited in this section, I was so far from having formed any hypothesis that led to the discoveries I made in pursuing them, that they would have appeared very improbable to me had I been told of them." Mr. Coutie lays this missile so very temptingly within our reach, that we may be excused for throwing it at his very fragile fabric.

The author's language does not properly fall into our province, but enough has been quoted to give our readers a fair specimen of its quality;—of Mr. Coutie's science no further criticism is necessary. R. M.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

### Theophrastus *versus* Millington

IN a letter in NATURE, vol. xiii. pp. 85, 86, Mr. Bennett appears to contend—

1. That if the credit of suggesting the true function of the stamens of flowering plants is to be attributed to either, it belongs to Grew rather than to Millington.

2. But that even the views of the former were not materially in advance of those of Theophrastus.

First, as to a bibliographical matter, Mr. Bennett speaks of a second edition of Grew's book. There is no such thing. The "Anatomy of Plants," 1682, contains four books; the first of these was published in 1671, the second in 1673, the third in 1675. The fourth book, not published till 1682, contains the celebrated passage on the sexuality of plants. This was read before the Royal Society, Oct. 26 [Nov. 9], 1676.

Turning to p. 172, we find Chap. V. "Of the Use of the Attire" (stamens).

In § 1 he alludes to the "Secundary use." This (book i. p. 39) he explains to be the provision of food for animals.

"We must not think that God Almighty hath left any of the whole Family of his Creatures unprovided for; but as the Great Master, some where or other carveth out to all; and that for a great number of these little Folk, He hath stored up their peculiar provisions in the Attires of Flowers; each Flower thus becoming their Lodging and their Dining-Room both in one."

Having given this proper recognition to the pious teleology of the time, he proceeds to remark in § 2 that "the Primary and chief Use of the Attire is such as hath respect to the Plant it self." He infers this very conclusively from the constant occurrence of stamens, even when the more conspicuous parts of the flower are wanting.

Then in the § 3 he tells us how Sir Thomas Millington gave him the clue—

"In discourse hereof [not as Mr. Bennett puts it, but on the nature of the Primary use of the Attire] with our Learned Savilian Professor, Sir Thomas Millington, he told me he conceived, That the Attire doth serve as the male, for the Generation of the seed."

In § 4 he proceeds: "I immediately reply'd, 'That I was of the same opinion;' and gave him some reasons for it, and answered some objections, which might oppose them."

Surely it is hardly necessary to comment on this charming little history. Grew gets the hint of the true solution from his friend, immediately perceives its importance, and eagerly proceeds to apply it to facts and to explain away apparent difficulties in accepting it. Surely scientific historians can hardly set aside Grew's own modest pleasure in attributing the discovery to Millington.

Next, however, we are told it is no discovery at all. It will be sufficient, in answer to this, to quote from p. 172 a few lines, omitting unnecessary analogies.

"The Globulets [pollen grains] and other small particles . . . in the Thecæ [anther-cells] are as the vegetable sperme which . . . falls down upon the seed-case [ovary] or womb, and so touches it with a prolifick virtue."

To say that Theophrastus in the fourth century B.C. possessed all the detailed information necessary to come so near the truth as Grew did in this statement, shows a wanton disregard for facts which it is sad to contemplate even though it be a momentary *lapsus* in the case of Mr. Bennett.

As to attributing all the credit in the matter to Camerarius, I cannot do better than appeal to an authority of which no one can question the impartiality.

Sprengel, in his "Historia rei Herbariæ," vol. ii. pp. 14, 15, has the following remarks:—

"Una fere cum Grewio Jacobus Bobartus, horti Oxoniensis præfectus, experimenta cum Lychnide dioica instituit (1681), quæ ovula in capsula obvia haudquaquam fœcunda esse, dum filamenta apicibus suis seu antheris careant, docuerunt. Id e Sherardi ore accepit Patricius Blair ("Botan. Essays," p. 243). Mox etiam Jo. *Raius* eamdem sententiam, de fœcundandi functione antherarum (1686) . . . uberrime et optime defendit. Unde elucet, *quantopere aberrent à veritate*, qui Rud. Jac. Camerarium inventorem credunt, licet plura hic argumenta pro sexuum differentia adduxerit. Cum historia spernat nationum arrogantiam, fatendum etiam est, Anglorum gloriam esse, quod primi tum phytotomiæ tum doctrinæ, quam sexualem dicunt, fundamenta jecerint."

There really is no case for discussion. Everyone is familiar with the fact that a large amount of time, paper, and ink may be wasted in contentions of this kind, and it is to be regretted that Mr. A. W. Bennett should employ his energies in furnishing additional experimental proof on this head. That the writer in NATURE and the reviewer of Sachs were each and severally justified in their allusion to Millington is also clear enough.

A. B. C.

### Estimation of Fractions

THE question of "Personal Equation in the Tabulation of Thermograms," &c., which was recently considered in this journal, is but a portion of the general subject of the estimation of fractions, and the various influencing causes connected with it. Having made some experiments on this matter some time ago, and more fully of late, I subjoin some of the results, as it is a subject on which there seems but little accurately known in general, and which is important in thousands of readings made every day.

The experimental readings were made with appliances varying in each case, but in all cases the whole space or division was perfectly free from any visible marks besides the movable index, as they might bias or help the division; also the reader avoided noticing during each set of readings whether they were mostly + or − the truth, as this would bias the judgment. Moderate sunlight shining on white paper led to more accurate results than

diffuse daylight. Each result stated below is the mean of from ten to fifty readings under fairly favourable circumstances. $d$ is used for the whole division or space on which the position of the index was estimated; and $i$ is the inch, which is the unit used throughout.

(1) The first question is the average amount of error made by different persons with regard to the fraction of *division*; in fact, the personal variation of average error. This on a 10-inch space was—

| | | |
|---|---|---|
| By A | mean error | $d \div 112$ |
| „ B | „ | $d \div 60$ |
| „ C | „ | $d \div 50$ |
| „ D | „ | $d \div 36$ |
| „ E | „ | $d \div 21$ |

(2) The average amount of error with regard to the fractions of an *inch* (the *divisions* being too small to see the above fractions of them) were—

| | | | | |
|---|---|---|---|---|
| By A | on space of | $i \div 41$ | mean error | $i \div 1890$ |
| „ A | „ | $i \div 139$ | „ | $i \div 3200$ |
| „ C | „ | $i \div 41$ | „ | $i \div 1640$ |

Under the best circumstances and reading with the right eye, A's mean error is only $i \div 5000$ on the space of $i \div 139$; and as the distance was about six inches, this is $\frac{1}{30000}$ of the distance; agreeing with the size of the smallest line visible, which is about $\frac{1}{25000}$ to $\frac{1}{60000}$ of the distance according to circumstances, but without any *shadow* to the wire examined. As to the observers, A has had practice lately in measuring; B had much practice some years ago; C and E are ladies of artistic tastes but unmetrical; D is moderately accustomed to measuring, but has a difference between the focus of his eyes. It would be highly interesting to have a good collection of statistics on this question, from among surveyors, mechanics, and the unmetrical classes. I proceed to readings for other points, made by A.

(3) The mean errors on spaces of various lengths stand thus:—

| | | | | |
|---|---|---|---|---|
| $10\,i$ space, | mean error | $d \div 112$ | | |
| $1\,i$ | „ | „ | $d \div 89$ | |
| ($i \div 41$ | „ | „ | $d \div 70$ | read by right eye only) |
| $i \div 41$ | „ | „ | $\therefore d \div 106$ | if read by both eyes. |

Thus the size of the division does not seem to much affect the estimation, the extreme difference being 4 : 5. If the angular width of a space exceed 5° it is not so easily grasped by the eye, though the error is not perceptibly increased till it exceeds 20°. The $i \div 41$ space was read with a magnifier, ($\times$ 3), so it was equivalent to $i \div 14$.

(4) The relative error of the first guess (or the numerical idea produced instantaneously at the first glance) and the most carefully considered readings stand thus:—

| | First sight. | Carefully considered. | Ratio. | Distance of observer. |
|---|---|---|---|---|
| $10\,i$ space, | $d \div 55$ | $d \div 114$ | 2·1 : 1 | $110\,i$ or $11d$ |
| $1\,i$ „ | $d \div 54$ | $d \div 78$ | 1·4 : 1 | $18\,i$ „ $18d$ |
| $i \div 139$ „ | $d \div 13{\cdot}6$ | $d \div 13$ | 1 : 1 | $6\,i$ „ $840d$ |

apparently indicating that the first guess is worst where the space is rather too wide angularly to be grasped by the eye at once; and therefore that the want of grasp is the defect corrected by consideration.

(5) The effect of looking at the space askew was tried by viewing it at 30° to either side; shifting sides ten times so as to avoid any gradual change in the quality of the reading, and so as to call up the contrast more strongly. The results of careful readings were:—

| | In sum of errors. per cent. + | − |
|---|---|---|
| $10\,i$ space to right hand ... ... ... | 31 | 69 |
| $10\,i$ „ left „ ... ... ... | 45 | 55 |

and it was noticeable that the fraction nearest to the reader was invariably guessed smaller at first sight, than it appeared on careful examination, showing that the tendency to diminish the nearest side which is noticeable in the above percentage of the space to right hand, was still stronger at first, and was corrected by consideration.

So far the results have been independent of differences between the eyes, but it would seem that these are considerable from the following:—

(6) Comparison of the percentage of + and − errors of the two eyes separately; the sum of the amounts of errors being taken, and not the number of errors.

| | Right eye. + | Right eye. − | | Left eye. + | Left eye. − | |
|---|---|---|---|---|---|---|
| $1\,i$ space ... | 55 | 45 | ... | 58 | 42 | white light |
| $1\,i$ „ ... | 75 | 25 | ... | 34 | 66 | coloured light |
| $i \div 139$ „ ... | 92 | 8 | ... | 28 | 72 | on silver |
| Mean ... | 73 | 27 | | 39 | 61 | |

The elements of this mean, and all others after, are weighted by the number of observations. As in all these readings the zero was to left hand, it would seem that each eye imagines the fraction on its own side smaller than it really is, this being in exact accordance with the effect produced by both eyes viewing the object from one side. See (5).

(7) When both eyes are used together the readings appear to be well balanced on an average:—

| | per cent. + | − |
|---|---|---|
| $10\,i$ space ... ... ... ... ... ... ... ... | 42 | 58 |
| $1\,i$ „ ... ... ... ... ... ... ... ... | 59 | 41 |
| Mean ... ... ... ... ... ... ... | 53 | 47 |

The variations, however, of different series of readings are as wide as + 80, − 20; and + 20, − 80; this may be partly due to temporary rest of one eye, involuntarily; and to a slightly skew view of the space.

(8) The comparative amount of error of the two eyes stands thus:—

| | Right | : | Left :: | |
|---|---|---|---|---|
| $1\,i$ space ... ... ... | 100 | : | 109 | white light |
| $1\,i$ „ ... ... ... | 100 | : | 120 | coloured lights |
| $i \div 139$ „ ... ... ... | 100 | : | 150 | on silver |
| Mean ... ... ... | 100 | : | 121 | |

So 5 : 6 is the relative error of the right and left eyes.

(9) The relative errors of each eye separately and of both together are:—

| | Right eye. | Left eye. | Mean of both. | Both used together. |
|---|---|---|---|---|
| $1\,i$ space ... | 1·52 ... | 1·64 ... | 1·59 ... | 1·00 |

So that the advantage of two eyes over one is more than $\sqrt[2]{2} : 1$, which it would be, if regarded as the mean of two readings; the excess of 1·59 over $\sqrt[2]{2}$ may be due to the restraint of keeping one eye shut. The accuracy seems to be about $\sqrt[1\frac{1}{2}]{\phantom{x}}$ the number of eyes.

(10) A most important practical question is that of the influence of colour on the error of estimation. On trying this with coloured glasses the results were most unexpected.

| | Relative amount of error. No glass. | Blue. | Green. | Red. |
|---|---|---|---|---|
| $1\,i$ space ... ... ... | 1·0 | ·81 | 1·06 | 1·70 |
| $1\,i$ „ ... ... ... ... | 1·0 | 1·17 | ·88 | 1·23 |
| Mean ... ... | 1·0 | ·99 | ·97 | 1·46 |

The two series (each of ten readings with each colour) are given to show how far uniform the results are; they were read on different days, completely reversing the order of the four columns; and they were equally divided between the eyes, five by right and five by left.

I had expected that red would hold about the above relation to white; but that green, and especially blue, would have been worse; the colours were spectrally tolerably pure, except the blue, which contained some yellow. The badness of blue on the second trial in diffuse daylight is accounted for by a want of sufficient light; blue containing such a small proportion of light-rays.

So far I have remarked on those points which are perhaps, or probably, *not* due to idiosyncrasies; the question of partiality for certain digits is clearly a personal error, as has been demonstrated in NATURE; so it is not worth noting further, as its interest in *individual* cases is confined to the observer, who should try (being "forewarned") to be "forearmed," and so allow for it in reading; of course a series of statistics on it would have much interest.

(11) One point, however, which is probably alike in all is the relative amount of error in different parts of a scale; the mean I find to be thus:—

| 0 to 1 | 1 to 2 | 2 to 3 | 3 to 4 | 4 to 5 | 5 to 6 | 6 to 7 | 7 to 8 | 8 to 9 | 9 to 10 |
|---|---|---|---|---|---|---|---|---|---|
| ·65 | 1·53 | 1·36 | 1·52 | 1·47 | 1·54 | 2·2 | 1·30 | 1·09 | 1·14 |
| − | + | − | + | + | + | + | − | [illegible] | [illegible] |

The + and − below show the mean error in that digit to exceed or fall short of the mean of all (1·44). The readings are on a 1-inch space. Thus it is apparent that the errors exceed the mean in the four middle digits, and fall short of it in the others with but one exception.

Now, the practical results which may be deduced from these data are as follows:—

From (1), that there is considerable variation in accuracy of estimation; yet, in persons fit to estimate, it may be put at $d \div 50$ up to $d \div 100$; and therefore as the maximum error in some hundreds of readings is only about three times the average error, it is useless (and, worse than that, confusing) to have divisions smaller than 20 × the quantity required to be read. The application of this result to surveyors' rods, &c., would be very conducive to ease in distant reading.

From (2), that for ordinary eyes about $i \div 2000$ is the mean error of reading (with one eye only), and therefore that $i \frac{80}{2000}$ is the smallest size useful for reading with the naked eye; consequently any closer divisions than these ($\frac{1}{25}$ of an inch) are detrimental because of the greater confusion they introduce.

From (4), that in small divisions no consideration is necessary, as the first instinctive impression is nearly, or quite, as accurate as careful estimation.

From (5), that it is important not to look at a space askew; and that if unavoidable, careful consideration is desirable.

From (6), that in reading a series of observations of one amount, the right and left eyes should be used alternately to equalise the + and − errors.

From (8), that the right eye should be used in preference to the left.

From (9), that both eyes should be used wherever possible.

From (10), that red is the worst colour for measures, and that green or blue are as good as white; so that blue and white would probably be the best practically, and more distinct from vegetation, &c., than the green at a distance.

From (11), that more care is required in readings in the central portions of a space than at the ends. This is as true on spaces of $i \div 41$ as on $10i$ spaces.

Of course some of these results may be *personal* errors, and not generally true, but at least this notice will perhaps call the attention of those accustomed to estimation to the subject, and so elicit some definite statistics. There are many other interesting questions which I have not touched on here as being of less consequence, and not affecting practical questions so much as the foregoing results; these results it is to be hoped may lead to a better acquaintance with a subject of such practical importance.

W. M. FLINDERS PETRIE

Bromley, Kent

### The late Dr. von Willemoes-Suhm

IN the list of papers given in Prof. Wyville Thomson's obituary of the late Dr. von Willemoes-Suhm (NATURE, vol. xiii., p. 88), is omitted—"Notes on some young stages of Umbellularia, and on its Geographical Distribution;" ("Ann. and Mag. Nat. Hist.," 4th ser., vol. xv., p. 312, and pl. xviii. A.) This animal is a Pennatulid, and was obtained during the *Challenger's* cruise at depths from 1,375 to 2,600 fathoms. It is usually associated with decidely deep-sea forms.

To this may be added two papers which were read at the meeting of the Royal Society on Dec. 9th, "On the Development of *Lepas Fascicularis*, and the '*Archizoëa*' of Cirripedia;" and "Preliminary Remarks on the Development of some Pelagic Decapoda."

J. C. G.

### Seasonal Order of Colour in Flowers

I HAVE often noticed during spring and summer that flowers appear to follow the spectrum from the blue of the wild hyacinth to the deep scarlet of our summer flowers. Will any of your correspondents tell me if during spring the actinic rays of the sun are in greater force, and whether these chemical rays are those which revivify seeds and plants after their winter's hibernation? During autumn I have noticed the same gradations in the colours of flowers.

C. E. HERON ROGERS

Retford, Notts, Dec. 7

## *OUR ASTRONOMICAL COLUMN*

ATLAS PLEIADUM, Σ 453.—Has anyone provided with a large telescope examined this object of late for duplicity? It appears very improbable that Struve's epoch of 1827 can have been put upon record through an illusion. We find in "Mensuræ Micrometricæ," p. 2:—

1827·16 Position 107°·8 Distance 0″·79 Mag. 5 and 8.

It is then termed "duplex difficillima." On subsequent examination, 1830·25, the position was found to be 29·2, and the distance only 0″·35. In 1831 and 1832 it was not seen double with the Dorpat refractor under a power of 600. Struve remarks, "si justa est anni 1827 notatio, quod vix dubitare potest, cum nullum observans dubium expresserim, motus in hoc systemate egregrie celer inesse debet." From 1840 to 1847, Mädler observing with the same instrument, says he always found the star "quite round," and to our knowledge a few years since the star was pronounced single after close scrutiny with more than one of the larger telescopes.

THE "GEGENSCHEIN" OF THE ZODIACAL LIGHT.—The last number of the "Monthly Notices of the Royal Astronomical Society" contains some interesting remarks by Mr. Backhouse, of Sunderland, bearing upon this phenomenon of the zodiacal light, as observed by him between the years 1871 and 1875, which are the more notable, as the observer does not appear to have been aware of its previous observation, and consequently the particulars he has placed upon record afford a very satisfactory confirmation of the existence of this feature of the light. The "gegenschein" consists in an elliptical patch of light almost directly opposite the sun's place, with the greater axis nearly in the plane of the ecliptic. Attention was first directed to it in the year 1854 by Herr Brorsen (the discoverer of the comet of short-period—February 1846)—while observing at Senftenberg in Bohemia. It may be inferred that it is generally difficult to distinguish or trace, with certainty, as even Prof. Heis, of Münster, with his excellent vision and long practice, did not succeed in verifying Brorsen's observations for several years (Zodiacallicht-Beobachtungen, Heis, 1875). Observations of the phenomenon will be found in various numbers of the "Astronomische Nachrichten." Brorsen thought this opposition-glow of the zodiacal light was more distinctly seen near the vernal than the autumnal equinox; the observations of Heis are in January, April, and in December. There are also observations by Schmidt at Athens, Schiaparelli at Milan, &c.

THE COMET OF 1729.—This very remarkable body presented a case which is quite unique in the history of these interesting denizens of the solar system. It was visible without telescopic aid, or with little optical assistance, at distances from the earth and sun not greatly inferior to those to which any other comet has been followed even with such an instrument as the Poulkova refractor, and it may be inferred was of very different constitution.

The comet was first detected by Sarabat, an ecclesiastic of the Jesuit order, at Nismes, on the 31st of July; the moonlight, which was then on the increase, prevented his seeing it on the following evenings until Aug. 8, when the moon being totally eclipsed, he recovered the comet and gave intimation of his discovery to Cassini at Paris, by whom it was observed on forty-four nights between Aug. 31 and Jan. 18 following. Cassini saw the comet without fixing its position until the end of the same month. While it was visible with difficulty to the naked eye, in a 16-feet telescope it appeared "en forme d'une petite étoile nébuleuse avec une chevelure autour d'elle, dont l'étendue paraisait au moins aussi grande que le diametre de Jupiter, vu avec une pareille lunette." This is about the extent of our information relating to the aspect of the comet.

The best orbits are those of Burckhardt (hyperbola and parabola), published in the "Connaissance des Temps" for 1821. If we employ the parabolic elements we find the following distances of the comet from the sun and earth expressed in units of the earth's mean distance from the sun:—

| 12h G.M.T. | Distance from Sun. | Distance from Earth. |
|---|---|---|
| 1729, July 31 | 4·065 | 3·121 |
| „ Aug. 8 | 4·072 | 3·134 |
| 1730, Jan. 18 | 4·452 | 5·152 |
| „ „ 31 | 4·499 | 5·225 |

For comparison with these distances take the case of the great comet of 1861, which was observed by Mr. Otto Struve at Poulkova till 1862, May 1, when its distance from the sun was 4·46, and from the earth 4·70; or that of Mauvais's comet of 1847, followed by Bond with the great refractor at Cambridge, U.S., till 1848, April 21, and then distant from the sun 3·85, and from the earth 4·40; or again, the case of the celebrated comet of 1811, last seen by Wisniewsky at Novo-Tcherkask, 1812, August 17, when the radius-vector was 4·54, and the distance from the earth 3·50.

## *RÜTIMEYER ON TRACES OF MAN RECENTLY DISCOVERED IN THE INTERGLACIAL COAL-BEDS OF SWITZERLAND*

THE last number of the *Archiv für Anthropologie* contains a short but important article by the eminent zoologist of Basle, Prof. Rütimeyer, on some traces of man recently discovered in the interglacial coal-bed at Wetzikon. Escher von der Linth first called attention to the fact that at several places in East Switzerland, especially on the eastern shore of Lake Zurich from Wetzikon to Utznach, and again in the neighbourhood of the Lake of Constance, there are beds of coal, which are not only covered by, but which also repose on, well-marked glacial deposits, thus clearly proving the existence of more than one period of extreme cold, as first remarked by Morlot, and since confirmed by many observers, and especially by Geikie.

These interglacial coal-beds contain numerous remains of plants and animals, among the most interesting being those of *Elephas antiquus* and *Rhinoceros merkii*. The remains of plants are indeed so numerous that Dr. Scheuermann, of Basle, has been in the habit of breaking up himself all the coal used as fuel in his house, in search of vegetable remains. In doing so he was struck on one occasion by observing a number of pointed rods lying side by side, and he placed the block of coal containing them in the hands of Prof. Rütimeyer.

Prof. Rütimeyer has now given a description and figures of these rods, from which it is clear that they have been intentionally pointed, and that they formed a portion of rough basket or wattle work. They are four in number, and are closely embedded in the coal, which they precisely resemble in colour, while the texture is that of the ordinary wood found in these coal-beds. Moreover, as is usual in such cases, the stem has been compressed, so that the section is not circular but oval. According to Prof. Schwendener, the wood is that of *Abies excelsa*. The points bear evident traces of cutting, while at one part of the rods are marks as if of a string wound round and round them. Here, then, we appear to have clear evidence of the existence of man during one of the warm intervals of the glacial epoch. J. L.

## *THE THEORY OF "STREAM LINES" IN RELATION TO THE RESISTANCE OF SHIPS* *

### III.

IN this treatment of the propositions concerning the flow of fluid through pipes, I have at length laid the necessary foundation for the treatment of the case of the flow of an infinite ocean past a submerged body. I have shown these propositions to be based on principles which are undeniable, and the conclusions from which, when in any way startling or paradoxical, you have seen confirmed by actual experiment.

I have dealt with the case of a single stream of uniform sectional area (and therefore of uniform velocity of flow) enclosed in a pipe of any path whatever; I have dealt with the case of a single stream of very gradually varying sectional area and velocity of flow; and I have dealt with the case of a combination (or faggot, as it were) of such streams, each to some extent curved and to some extent varying in sectional area, together composing the whole content of a pipe or passage having enlargements or contractions in its course; and in all these cases I have shown that, provided the streams or pipe-contents finally return to their original path and their original velocity of flow, they administer no total endways force to the pipe or channel which causes their deviations.

I am now going to deal with a similar combination of such streams, which, when taken together, similarly constitute an infinitely extended ocean, flowing steadily past a stationary submerged body; and here also I shall show that the combination of curved streams surrounding the body, which together constitute the ocean flowing past it, return finally to their original direction and velocity, and cannot administer to the body any endways force.

The argument in this case is, in reality, precisely the same as that in the case of the contractions and enlargements in pipes which I have already dealt with; for, in fact, the flow of the ocean past the stationary submerged body is only a more general case of the flow of fluid through a contracted pipe; but, though the cases are really the same, there is considerable difference in their appearance; and therefore I will proceed to point out how the arguments I have already used apply equally to this case.

Every particle of the fluid composing the ocean that passes the body must undoubtedly follow some path or other, though we may not be able to find out what path; and every particle so passing is preceded and followed by a continuous stream of particles all following the same path, whatever that may be. We may, then, in imagination, divide the ocean into streams of any size and of any cross-section we please, provided they fit into one another, so as to occupy the whole space, and provided the boundaries which separate the streams exactly follow the natural courses of the particles.

I before suggested a similar conception of the constitution of the ocean flowing past the stationary body, and there pointed out that the streams forming this system must not only be curved in order to get out of the way of the body, but might each require to have to some extent a different sectional area, and therefore a different velocity of flow at different points of their course. If we trace the streams to a sufficient distance ahead of the body, we shall there find the ocean flowing steadily on, completely undisturbed by, and as we may say ignorant of, the existence of the body which it will ultimately have to pass. There, all the streams must have the same direction, the same velocity of flow, and the same pressure. Again, if we pursue their course backwards to a sufficient distance behind the body, we shall find them all again flowing in their original direction; they will also have all resumed their original velocity; for otherwise, since the velocity of the ocean as a whole cannot have changed, we should have a number of parallel streams having different velocities and therefore different pressures side by side with one another, which is an impossible state of things.*

Although, in order to get past the body, these streams follow some courses or other, various both in direction and velocity, into which courses they settle themselves in virtue of the various reactions which they exert upon one another and upon the surface of the body, yet ultimately, and through the operation of the same causes, they settle themselves into their original direction and original velocity. Now the sole cause of the original departure of each and all of these streams from, and of their ultimate return to, their original direction and velocity, is the submerged stationary body; consequently the body must receive the sum total of the forces necessary to thus affect them. Conversely this sum total of force is the only force which the passage of the fluid is capable of administering to the body. But we know that to cause a single stream, and therefore also to cause any combination or system of streams, to follow any courses

* Address to the Mechanical Section of the British Association, Bristol, August 25, 1875; by William Froude, C.E., M.A., F.R.S. President of the Section. Revised and extended by the author. Continued from p. 93.

* In an imperfect fluid it *is* possible to have parallel streams having different velocities and the same pressures side by side with one another, because, in an imperfect fluid, change of velocity may have been communicated by friction instead of by difference of pressure.

changing at various points both in direction and velocity, requires the application of forces the sum total of which in a longitudinal direction is *zero*, as long as the end of each stream has the same direction and velocity as the beginning. Therefore the sum total of forces (in other words the only force) brought to bear upon the body by the motion of the fluid in the direction of its flow, is *zero*.*

I have now shown how it is that an infinite ocean of perfect fluid flowing past a stationary body cannot administer to it any endways force, whatever be the nature of the consequent deviations of the streams of fluid. The question, what will be in any given case the precise configuration of those deviations, is irrelevant to the proof I have given of this proposition. Nevertheless it is interesting to know something, at least, of the general character which these deviations, or "stream-lines," assume in simple cases; therefore I have exhibited some in Figs. 26, 27, which are drawn according to the method explained by the late Prof. Rankine.

The longitudinal lines represent paths along which particles flow; they may therefore be regarded as boundaries of the streams into which we imagined the ocean to be divided.

We see that, as the streams approach the body, their first act is to broaden, and consequently to lose velocity, and therefore, as we know, to increase in quasi-hydrostatic pressure. Presently

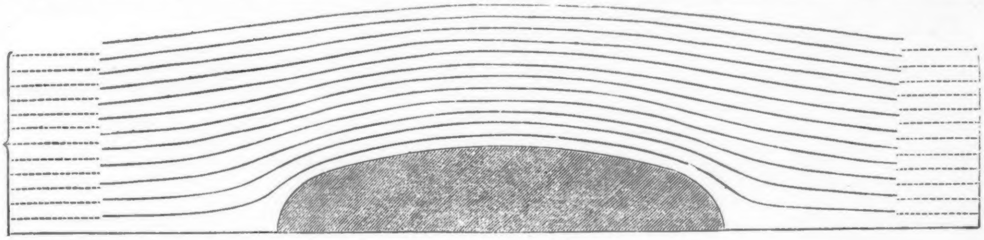


FIG. 26.

they again begin to narrow, and therefore quicken, and diminish in pressure, until they pass the middle of the body, by which time they have become narrower than in their original undisturbed condition, and consequently have a greater velocity and less pressure than the undisturbed fluid. After passing the middle they broaden again until they become broader than in their original condition, and therefore have less velocity and greater pressure than the undisturbed fluid. Finally, as they recede from the body they narrow again until they ultimately resume their original dimension, velocity, and pressure.

Thus, taking the pressure of the surrounding undisturbed fluid as a standard, we have an excess of pressure at both the head and stern ends of the body, and a defect of pressure along the middle.

We proved just now that, taken as a whole, the fluid pressures could exert no endways push upon the stationary body. We now see something of the way in which the separate pressures act, and that they do not, as seems at first sight natural to expect, tend all in the direction in which the fluid is flowing; on the contrary, pressure is opposed to pressure, and suction to

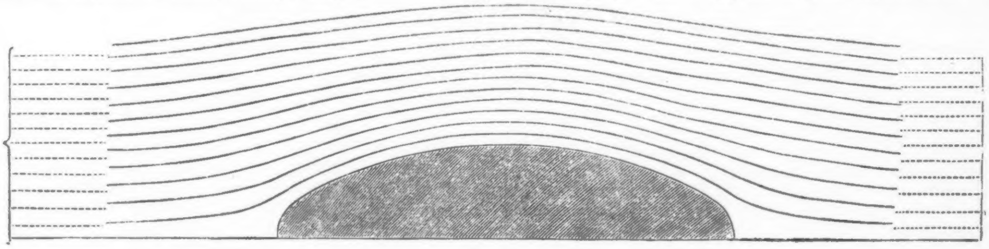


FIG. 27.

suction, and the forces neutralise one another and come to nothing, and thus it is that an ocean of perfect fluid flowing at steady speed past a stationary submerged body does not tend to push it in the direction of the flow. This being so, a submerged body travelling at steady speed through a stationary ocean of perfect fluid will experience no resistance.

We will now consider what will be the result of substituting an ocean of water for the ocean of perfect fluid.

The difference between the behaviour of water, and that of the theoretically perfect fluid is twofold, as follows:—

First. The particles of water, unlike those of a perfect fluid, exert a drag or frictional resistance upon the surface of the body as they glide along it. This action is commonly termed surface-friction, or skin-friction; and it is so well-known a cause of resistance that I need not say anything further on this point, except this, that it constitutes almost the whole of the resistance experienced by bodies of tolerably easy shape travelling under water at any reasonable speed.

Secondly. The mutual frictional resistance experienced by the particles of water in moving past one another, combined with

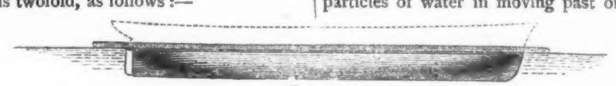


FIG. 28.

the almost imperceptible degree of viscosity which water possesses, somewhat hinders the necessary stream-line motions, alters their nice adjustment of pressures and velocities, and thus defeats the balance of stream-line forces and induces resistance. This action, however, is imperceptible in forms of fairly easy shape. On the other hand, angular or very blunt features entail considerable resistance from this cause, because the stream-line distortions are in such cases abrupt, and degenerate into eddies, thus causing great differences of velocity between adjacent particles of water, and great consequent friction between them.

"Dead water," in the wake of a ship with a full run, is an instance of this detrimental action.

So far we have dealt with submerged bodies only; we will now take the case of a ship travelling at the surface of the water. But first, let us suppose the surface of the water to be covered with a sheet of rigid ice, and the ship cut off level with her water-line, so as to travel beneath the ice, floating, however, exactly in the same position as before (see Fig. 28). As the ship travels along, the stream-line motions will be the same as for a submerged body, of which the ship may be regarded as the lower half; and the ship will move without resistance, except that due

* See Supplementary Note C.

to the two causes I have just spoken of, namely surface-friction and mutual friction of the particles. The stream-line motions being the same in character as those we have been considering, we shall still have at each end an excess of pressure which will tend to force up the sheet of ice, and along the side we shall have defect of pressure tending to suck down the sheet of ice. If, now, we remove the ice, the water will obviously rise in level at each end, so that excess of hydrostatic head may afford the necessary reaction against the excess of pressure; and the water will sink by the sides, so that defect of hydrostatic head may afford reaction against the defect of pressure.

The hills and valleys thus formed in the water are, in a sense, waves; and, though originated in the stream-line forces of the body, yet when originated they come under the dominion of the ordinary laws of wave-motion, and, to a large extent, behave as independent waves.

The consequences which result from this necessity are most intricate; but the final upshot of all the different actions which take place is plainly this—that the ship in its passage along the surface of the water has to be continually supplying the waste of an attendant system of waves, which, from the nature of their constitution as independent waves, are continually diffusing and transmitting themselves into the surrounding water, or, where they form what is called broken water, crumbling away into froth. Now, waves represent energy, or work done; and therefore all the energy represented by the waves wasted from the system attending the ship, is so much work done by the propellers or tow-ropes which are urging the ship. So much wave-energy wasted per mile of travel is so much work done per mile; and so much work done per mile is so much resistance.

The actions involved in this cause of resistance, which is sometimes termed "Wave-Genesis," are so complicated that no extensive theoretical treatment of the subject can be usefully attempted. All that can be known about the subject must, for the present, I believe, be sought by direct experiment.

Having thus briefly described the several elements of a ship's resistance, I will proceed to draw your attention more particularly to certain resulting considerations of practical importance. Do not, however, suppose that I shall venture on dictating to shipbuilders what sort of ships they ought to build: I have so little experience of the practical requirements of shipowners, that it would be presumptuous in me to do so; and I could not venture to condemn any feature in a ship as a mistake, when, for all I know, it may be justified by some practical object of which I am ignorant. For these reasons, if I imply that some particular element of form is better than some other, it will be with the simple object of illustrating the application of principles, by following which it would be possible to design a ship of given displacement, to go at given speed, with minimum resistance, in smooth water—in fact, to make the best performance in a "measured mile" trial.

I have pointed out that the causes of resistance to the motion of a ship through the water are: first, surface-friction; secondly, mutual friction of the particles of water (and this is only practically felt when there are features sufficiently abrupt to cause eddies); and thirdly, wave-genesis. I have also shown that these are the *only* causes of resistance. I have shown that a submerged body, such as a fish, or torpedo, travelling in a perfect fluid, would experience no resistance at all; that in water it experiences practically no resistance but that due to surface-friction and the action of eddies; and that a ship at the surface experiences no resistance in addition to that due to these two causes, except that due to the waves she makes. I have done my best to make this clear: but there is an idea that there exists a kind of resistance, a something expressed by the term "direct head-resistance," which is independent of the above-mentioned causes. This idea is so largely prevalent, of such long standing, and at first sight so plausible, that I am anxious not to leave any misunderstanding on the point.

Lest, then, I should not have made my meaning sufficiently clear, I say distinctly, that the notion of head-resistance, in any ordinary sense of the word, or the notion of any opposing force due to the inertia of the water on the area of the ship's way, a force acting upon and measured by the area of midship section, is, from beginning to end, an entire delusion. No such force acts at all, or can act; as throughout the greater part of this address I have been endeavouring to explain. No doubt, if two ships are of precisely similar design, the area of midship section may be used as a measure of the resistance, because it is a measure of the size of the ship; and if the ships were similar in every respect, so also would the length of the bowsprit, or the height of the mast, be a measure of resistance, and for just the same reason. But it is an utter mistake to suppose that any part of a ship's resistance is a direct effect of the inertia of the water which has to be displaced from the area of the ship's way. Indirectly the inertia causes resistance to a ship at the surface, because the pressures due to it make waves. But to a submerged body, or to the submerged portion of a ship travelling beneath rigid ice, no resistance whatever will, be caused by the inertia of the water which is pushed aside. And this means that, if we compare two such submerged bodies, or two such submerged portions of ships travelling beneath the ice, as long as they are both of sufficiently easy shape not to cause eddies, the one which will make the least resistance is the one which has the least skin surface, though it have twice or thrice the area of midship section of the other.

The resistance of a ship, then, practically consists of three items—namely, surface-friction, eddy-resistance, and wave-resistance.

Of these the first-named is, at least in the case of large ships, much the largest item. In the *Greyhound*, a bluff ship of 1,100 tons, only 170 feet long, and having a thick stem and sternposts, thus making considerable eddy-resistance, and at ten knots visibly making large waves, the surface-friction was 58 per cent. of the whole resistance at that speed; and there can be no doubt that with the long iron ships now built, it must be a far greater proportion than that. Moreover the *Greyhound* was a coppered ship; and most of the work of our iron ships has to be done when they are rather foul, which necessarily increases the relative importance of the surface-friction item.

The second item of resistance, namely the formation of eddies, is, I believe, imperceptible in ships as finely formed as most modern iron steamships. Thick square-shaped stems and sternposts, more especially the latter, are the most fruitful source of this kind of resistance.

The third item is wave-resistance. To this alone of the three is the stream-line theory directly relevant, and here, as we have seen, it rather suggests tendencies, than supplies quantitative results, because, though it indicates the nature of the forces in which the waves originate, the laws of such wave-combinations are so very intricate, that they do not enable us to predict what waves will actually be formed under any given conditions.

There are, however, some rules, I will not call them principles, which have to some extent been confirmed by experiment. At a speed dependent on her length and form, a ship makes a very large wave-resistance. At a speed not much lower than this, the wave-resistance is considerably less, and at low speeds it is insignificant. Lengthening the entrance and run of a ship tends to decrease the wave-resistance; and it is better to have no parallel middle body, but to devote the entire length of the ship to the entrance and run, though in this case it be necessary to increase the midship section in order to get the same displacement in a given length.

With a ship thus formed, with fair water-lines from end to end, the speed at which wave-resistance is accumulating most rapidly, is the speed of an ocean-wave the length of which, from crest to crest, is about that of the ship from end to end.

I have said we may practically dismiss the item of eddy-resistance. The problem, then, to be solved in designing a ship of any given size, to go at a given speed with the least resistance, is to so form and proportion the ship that at the given speed the two main causes of resistance, namely surface-friction and wave-resistance, when added together, may be a minimum.

In order to reduce wave-resistance we should make the ship very long. On the other hand, to reduce the surface-friction we should make her comparatively short, so as to diminish the area of wetted skin. Thus, as commonly happens in such problems, we are endeavouring to reconcile conflicting methods of improvement; and to work out the problem in any given case, we require to know actual quantities. We have sufficient general data from which the skin resistance can be determined by simple calculation; but the data for determining wave-resistance must be obtained by direct experiments upon different forms to ascertain its value for each form. Such experiments should be directed to determine the wave-resistance of all varieties of water-line, cross section, and proportion of length, breadth, and depth, so as to give the comparative results of different forms as well as the absolute result for each.

An exhaustive series of such experiments could not be tried with full-sized ships; but I trust that the experiments I am now

carrying out with models, for the Admiralty, are gradually accumulating the data required on this branch of the subject.

I wish in conclusion to insist again, with the greatest urgency, on the hopeless futility of any attempt to theorise on goodness of form in ships, except under the strong and entirely new light which the doctrine of stream-lines throws on it.

It is, I repeat, a simple fact that the whole framework of thought by which the search for improved forms is commonly directed, consists of ideas which, if the doctrine of stream-lines is true, are absolutely delusive and misleading. And real improvements are not seldom attributed to the guidance of those very ideas which I am characterising as delusive, while in reality they are the fruit of painstaking, but incorrectly rationalised, experience.

I am but insisting on views which the highest mathematicians of the day have established irrefutably; and my work has been to appreciate and adapt these views when presented to me.*

No one is more alive than myself to the plausibility of the unsound views against which I am contending; but it is for the very reason that they are so plausible that it is necessary to protest against them so earnestly; and I hope that in protesting thus, I shall not be regarded as dogmatic.

In truth, it is a protest of scepticism, not of dogmatism; for I do not profess to direct anyone how to find his way straight to the form of least resistance. For the present we can but feel our way cautiously towards it by careful trials, using only the improved ideas which the stream-line theory supplies, as safeguards against attributing this or that result to irrelevant or, rather, non-existing causes.

(*To be continued.*)

## *THE CHANNEL TUNNEL—SUBMARINE EXPLORATIONS*†

AN important Report in connection with the proposed Channel Tunnel has just been issued by the French Submarine Railway Association, giving the results of a detailed examination of the French coast, and of soundings taken in the bed of the Channel during the past autumn. The subject has on previous occasions been referred to in the pages of this Journal; ‡ but before giving an account of the recent explorations it may be well briefly to refer to what has already been done.

A tunnel under the Channel has long been talked of, and many schemes have been brought forward; but the only one which has been received with general favour is that of Sir J. Hawkshaw, who proposes to carry the tunnel from the South Foreland to near Sangatte. In 1864 Mr. E. C. H. Day was employed by Sir J. Hawkshaw to make a geological survey of the neighbouring coasts with the view of obtaining some guide as to the probable outcrops beneath the Channel; the map thus produced was published with the early statements of the Company. In 1866 borings were made on both coasts to prove the succession of the strata at points near which the tunnel was to leave the shores; that on the shore at St. Margaret's Bay traversed 240 feet of upper chalk and 296 feet of lower chalk, and was stopped in the gault at a depth of 567 feet from the surface. The boring on the French coast was put down a little north of Sangatte; it passed through 70 feet of drift-sand, &c., 190 feet of chalk with flints, 284 feet of chalk without flints, and was stopped at a depth of 551 feet from the surface owing to an accident to the hole. This boring, therefore, did not reach the Upper Greensand, and the depth to this bed was estimated from information obtained in the deep boring at Calais. This accident was unfortunate, because, owing to a misreading of the accounts of the Calais boring, I believe that the thickness of the lower chalk was considerably over-estimated at Sangatte.

At a later date soundings were taken along the line of the proposed tunnel, and at varying distances to the south-west of that line; the instrument used penetrated the bottom for a few inches, and brought up specimens of the ocean floor. The larger number of these were from the superficial covering (sand, &c.), but many brought up pure chalk, and several specimens of gault were obtained near the English coast. This examination was not detailed enough to test very severely the geological map; but so far as the information went it tended to confirm the previous surveys; the only difference then observed was that the gault appeared to run rather further north towards Dover than would have been expected. But it may be doubtful whether such small borings always give trustworthy evidence on this point. The lowest beds of chalk are very clayey, and when thoroughly saturated with water are often quite dark and bluish in colour. In fact, these lowest beds, when freshly exposed in railway cuttings, have been at first mistaken for gault by good observers.

No further explorations have been made till the present year. The concession to the Company was voted by the National Assembly on the 2nd of August, and was signed by Marshal MacMahon on the 5th of the same month. Anticipating the result of the vote the Company commenced work in July. By means of a steamer, soundings were taken on the bed of the Channel. A tube was fixed at the bottom of the sounding-lead, by means of which specimens were brought up. Various appliances were used, but tubes of from 20 to 22 millimètres in diameter, and 15 to 20 centimètres long were found to give the best results. The number of soundings taken per day varied according to circumstances; it averaged 70 or 80, but sometimes reached 100.

The Commission entrusted with the explorations was presided over by M. Lavalley, and consisted of MM. Delesse, Potier, and Lapparent as geologist, and M. Larousse as hydrographer. The position of the boat was at each observation carefully determined by bearings on landmarks. Every specimen collected was marked and sent to Paris for future determination and reference. In all 1,522 soundings were made; 753 specimens of the bottom were obtained, of which 335 have been determined with certainty.

The results show that the outcrop of the gault makes a bend to the north just off the French coast. The Commission carefully tested this district by divers (the water being shallow), and they believe that this bend is due to an anticlinal fold of the strata, and not to a fault; the dip of the beds probably not exceeding 10°. From the French waters across the Channel as far as the observations went (to within about five miles of the English coast), the beds run with great regularity. Supposing the observations to be trustworthy, there cannot be a transverse fault of any magnitude along this line. But the outcrop of the gault lies further to the south than was expected; in fact, it is striking direct for Folkestone church. As before remarked, the earlier observations showed the gault near the English shore to run a little further to the north than was expected; so that here there must either be a roll of the beds or a fault with a downthrow to the south-east.* The engineers point out the importance of following up this inquiry, and doubtless it will be done as early as possible next year.

No one has expected to tunnel through twenty miles of chalk without meeting with a fault, and therefore the possibility of encountering one near the English shore need cause no uneasiness. It may give no extra trouble, or yield no more water than the rest of the work. Faults are often cut in coal workings under the sea, but they do

* I cannot pretend to frame a list of the many eminent mathematicians who originated or perfected the stream-line theory; but I must name, from amongst them, Prof. Rankine, Sir William Thomson, and Prof. Stokes, in order to express my personal indebtedness to them for information and explanations, to which chiefly (however imperfectly utilised) I owe such elementary knowledge of the subject as alone I possess.

† Chemin de Fer Sous-Marin entre la France et l'Angleterre. Rapports sur les Sondages exécutés dans le Pas de Calais en 1875. Fol., Paris, 1875.

‡ Vol. i. pp. 160, 303, 631. Prof. Hébert made a communication to the meeting of the British Association at Bristol, on the folds likely to occur beneath the Channel. (See NATURE, vol. xii. p. 407.)

* Mr. G. H. Kinahan, writing to me last year, expressed his belief in the existence of a considerable fault in the Channel, with a downthrow to the south-east.

not cause any uneasiness or extra expense on this account. For the rest the explorations are highly satisfactory, and the extension southwards of the gault is no disadvantage.

Besides the outcrop of the "craie glauconieuse," which almost corresponds to the outcrop of the gault, the engineers profess to have determined the line between the "craie de Rouen," or lower chalk, and a nodular bed which lies above it. One cannot help feeling doubts as to the possibility of this being done, with any degree of certainty, by the means at their disposal. It is, however, important to fix if possible the breadth of outcrop of one of the beds; because, the thickness being known, we can thus estimate the dip. The soundings, as interpreted by the Commission, show that the dip is greatest near the French coast, and that it gets gradually less towards the English coast. Borings at and near Calais show that the dip there lessens towards the north, and by analogy it may be inferred that towards the proposed tunnel the beds under the sea will also lessen in dip.

It is proposed to continue the soundings further north, with the view of fixing exactly the outcrops of the higher beds of chalk. As the report states, if these attempts are successful we shall know exactly, and not by hypothesis, the geological structure of the strait. We shall know too the geological structure of the bed of the sea better than we now know that of much of the dry land; for no geologist has attempted to trace out all the chalk divisions on either coast; they have been measured in the cliffs, but not mapped in detail inland.

The Commission recommends that a new and larger borehole be put down at Sangatte with the view of testing the water-bearing qualities of the chalk at different levels, and of proving the exact thickness of the chalk. It is proposed to carry the hole through the gault and into the Palæozoic rocks, with the view of testing whether these rocks are absorbent, and capable of carrying off water from the tunnel. The *possibility* that they may serve this purpose has been suggested by the present writer.* The Commission proposes to test the point, but observes that it is unlikely to be the case. The Palæozoic rocks yield water near Lille, though they have not done so at Calais and Harwich; this may be because the old rocks are only slightly permeable, and if so they will be only slightly absorbent. It was on this gronnd that Prof. Prestwich proposed to tunnel through the Palæozoic rocks.

The Commission has examined in great detail the chalk of the French cliffs, and the results of their observations are drawn in a section in this Report. W. Phillips in 1819 published a description of the cliffs on each side of the Channel. So far as his observations go they are exact, and need no correction; later observers having only worked out the beds in greater detail. The Report refers in terms of well-merited praise to this early work of Phillips, but it is slightly in error in stating that English geologists have done nothing since his time. The Geological Survey has been over the ground; the maps are published, and descriptions have been given by Mr. Whitaker. Mr. Dowker has also studied the higher chalk of Kent.

The Report contains a large chart showing the positions of all the soundings, and is further illustrated by sections and diagrams in the text. It is one of the most valuable publications which has yet appeared on this important subject, and is well worthy of the reputation of its distinguished authors.

W. TOPLEY

* Quart. Journ. Science, April 1872.

## NOTES

IT is with great regret that we hear of the death of Mr. R. C. Carrington, F.R.S., whose name is so intimately associated with solar observation, which indeed he was the first to start in this country. His failing health of late years, was no doubt due to his unceasing assiduity. For seven and a quarter years scarcely a single day passed that Mr. Carrington did not make an observation on sun-spots. The book which contains these observations, published by Williams and Norgate, partly at the expense of the Royal Society, is one of the astronomical works of which England has good cause to be proud. Up to his death Mr. Carrington was engaged in designing and planning instruments of more than curious construction, which he intended eventually to fit up in his observatory. Before he took up sun-spot observations he constructed charts and a catalogue of the circumpolar stars, into which he introduced the most minute accuracy. The "Redhill Catalogue" will long be consulted by the practical astronomer.

AT the meeting of the Royal Society on Thursday last, the following Fellows were appointed Vice-Presidents of the Society for the ensuing year:—Mr. William Spottiswoode, M.A.; Prof. J. Couch Adams, LL.D.; Captain F. J. O. Evans, R.N.; Dr. A. C. Günther, M.A., and Dr. William Pole, C.E.

COUNT SALVADORI, of the Royal Museum of Turin, has recently described in the "Annals of the Civic Museum of Natural History of Genoa," a large new rapacious bird, discovered by the naturalist D'Albertis in New Guinea, which he proposes to call *Harpyopsis novæ Guineæ*. The existence of this bird probably gave rise to the exaggerated report of the enormous "eagles" which were seen during the voyage up an unexplored river in New Guinea, recently published in the *Daily News* (NATURE, vol. xiii., p. 76.)

AT Monday's meeting of the Royal Geographical Society the paper read was by Mr. Octavius Stone, on the discovery of the Mai-Kassa or Baxter River, New Guinea. Mr. Stone sailed up the river in the missionary vessel *Ellangowan*, and the account given is essentially the same as that which has already appeared in our journal, though Mr. Stone seems to make no mention of the monstrous bird referred to by Mr. Smithurst (vol. xiii., p. 76.) At the furthest point reached (about 100 miles from the mouth) the Mai-Kassa was ten yards wide, although the depth was still two fathoms. Even so far in the interior it is influenced by four half-tides daily, as when the first waters meet the sea a rebound is caused, so that the second half-tide is of slightly longer duration than the first. The rise of tide at the furthest point is from 3 feet to 4 feet, but its waters are entirely fresh. It is on account of the sluggish motion and continued depth of this river that Mr. Stone believes it may run for another 100 miles into the interior. A boa-constrictor was shot, 15 ft. 3 in. long, having a protuberance in his body 14½ inches in diameter, which, when cut open, proved to be the body of a whole kangaroo only partially digested.

LAST Saturday's meeting at Bristol, under the presidency of the Mayor, in connection with the proposed University College of that city, was quite a successful one. A constitution, sufficiently comprehensive, was adopted, on the basis of which the general committee were empowered to incorporate the college, and to prepare the necessary legal documents. Thus the college may now be regarded as fairly set afloat, and judging from the enthusiasm of the meeting we should think it likely that it will soon be at work. Out of 40,000*l*. which were wanted, 22,000*l*. have been collected mainly in Bristol and neighbourhood; besides which, it is stated, some colleges at Oxford are willing to give 1,000*l*. a year towards University teaching at Bristol. Among those who spoke were Prof. Jowett and the Rev. Mr. Robinson, of New College, Oxford.

WE are authoritatively informed that the delay which has this year taken place in the zoological publications of the Linnean Society will not occur again, and has depended on causes over which the zoological secretary has no control, and for which he is not responsible.

PROF. MAX MÜLLER has been elected a Knight of the Order of Maximilian for Science and Art. The election to this Order, as to the Order *pour le mérite*, rests with the Knights themselves, and is confirmed by the King of Bavaria.

OUR letter last week (p. 106) on the late Dr. Stoliczka's collection of mammals was from Major H. H. Godwin-Austen, Deputy Superintendent of the Topographical Survey of India.

WE take the following from the *Pall Mall Gazette*:—In his last book ("Ziele und Wege der heutigen Entwickelungsgeschichte") Prof. Haeckel, the great apostle of Evolutionism in Germany, announces the discovery of the following law:—"In all the magnificent scientific institutes founded in America by Agassiz, the following empirical law, long recognised in Europe, has been confirmed,—viz. that the scientific work of these institutes and the intrinsic value of their publications stand in an inverse ratio to the magnitude of the buildings and the splendid appearance of their volumes." "I need only refer," he adds, "to the small and miserable institutes, and the meagre resources with which Baer in Königsberg, Schleiden in Jena, Johannes Müller in Berlin, Liebig in Giessen, Virchow in Würzburg, Gegenbaur in Jena have not only each advanced their special science most extensively, but have actually created new spheres for them. Compare with these the colossal expenditure and the luxurious apparatus in the grand institutes of Cambridge, Leipzig, and other so-called great universities. What have they produced in proportion to their means?"

IT is stated in communications received by the Scottish Meteorological Society from their observers in Iceland, that the volcanic eruptions continued till the 18th October, but since then no fresh eruptions have been noted. Up to the 4th inst. the weather in Iceland continued to be remarkably mild, little snow had fallen, and frost had been only of occasional occurrence.

The *Times* Naples correspondent, writing under date Dec. 7, gives details concerning the state of Vesuvius, which confirm Prof. Palmieri's prognostication referred to by us in a recent number (p. 94). The mountain is evidently in a state of great internal agitation, and all the circumstances seem to forbode an early eruption. There have been several earthquake shocks recently in Naples and the surrounding region, one of the most alarming being at 3.24 A.M. on the 6th. Prof. Palmieri does not, however, consider Vesuvius to be the centre of the disturbances; he is inclined to place it at Puglia.

A BOMBAY telegram states that a severe shock of earthquake was felt on Sunday last at Lahore and in the Peshawur district. Several lives were lost.

NEWS has been received lately from Gen. Nausouty and one of his friends who are spending the winter on the Pic du Midi, one of the most elevated mountains in the Pyrenean range, for the purpose of registering meteorological phenomena. The temperature of 22° cent. below zero C. was recorded during the recent cold weather. The observers, however, felt no inconvenience, as the interior temperature of the observatory was always kept above + 10° C. Last year this was impossible, and the observers were obliged to give up their task and to return to warmer regions, being almost starved and frozen to death when retreating.

ON December 5, at two o'clock in the afternoon, a slight earthquake was felt at Blideh, province of Algiers; the duration was only two seconds. A great storm was raging.

THE *Gazetta Medica di Roma*, which has reached its fifth number, is a journal we would commend to the attention of those interested in scientific medicine. It is well conducted and printed, and the original articles seem to us to be of a high class, creditable altogether to Italian medical research.

THE Auckland (New Zealand) *Southern Cross* hears from Taupo that Mount Tongariro is in a high state of activity, throwing stones for a distance of eight miles from the crater. All the springs and geysers in the neighbourhood are in full play, and some wonderful sights may be seen in this extraordinary region.

AT Rotherham the Committee formed in the town to conduct the Science Classes contains the following: a Clergyman of the Established Church holding the rank of Doctor of Divinity, a Unitarian Minister, a Wesleyan Minister, a Primitive Methodist Minister, and an Independent Minister. We do not need to point the moral.

A NEW periodical has been started in Paris, under the title of *Tour de France*. It records excursions within the borders of the French Republic, and contains maps and illustrations. It will do for France what the *Tour du Monde* does for foreign parts, its aim being to remind Frenchmen of the natural resources and beauties of their own land.

IN the beginning of 1876 there will be opened at Paris, in the Champs Elysées Palace, an exhibition, including all the objects relating to the exploitation of railways and electric telegraphs. This exhibition will interfere in no way with the contemplated Electrical Exhibition which is to take place in 1877.

MR. CASELLA, the well-known scientific instrument-maker, has sent us a specimen of a compass which will be a great boon to the many who are ignorant of the difference between the magnetic and the geographical poles, and of the fact that an ordinary compass points to the former and not to the latter, the difference in this country at present being about 19° The great advantage of Mr. Casella's "unmistakable true north compass," is that it points to the true or geographical north, being corrected for use in the United Kingdom, and capable of adaptation to any locality in any part of the world. It is a card compass of beautiful workmanship, swings with perfect ease, and by means of a black cone on a white ground, the merest tyro can read it. It is made in various sizes, and sold at various prices, and deserves to come into extensive use.

THE projected programme of vegetable products issued by the Commission of the International Horticultural Exhibition, proposed to be held at Amsterdam in 1877, is one of the best, if not the best, we ever remember seeing. It contains a list of fourteen distinct articles, upon each of which information of the fullest description is asked, from a complete set of specimens of any particular plant of economic value through its various species or varieties down to the implements used in the collection or preparation of the product and the books or writings bearing on the subject. In the matter of vegetable fats and oils, as well as in paper materials, large fields of work present themselves, and much matter of great interest may be exhibited. If the exhibition is carried out in accordance with the designs of the projectors it cannot fail to be most successful and interesting.

TWO lectures, suited for a juvenile audience, will be given in connection with the Society of Arts, on Tuesday, January 4, and Tuesday, January 11, by Dr. W. B. Carpenter, F.R.S., on "The Wonders of the Microscope." the lectures will commence at 7 P.M., and will be illustrated by the oxyhydric and electric lights.

A SAD balloon accident occurred at Vincennes, near Paris, on the 8th inst. The balloon *Univers* having started at 11 o'clock in the morning descended with terrific force thirty-five minutes later from an altitude of 1,000 feet. The balloon was in charge of Eugene Godard, one of the most experienced French aëronauts. Eight persons were on board, amongst whom were Col. Laussedat and some officers who had made the ascent for topographical

purposes. Four persons were injured and the others experienced severe bruises. The real cause of the catastrophe is to be investigated officially by M. Giffard, the celebrated French engineer. At present it is supposed that the band of india-rubber which acts as a spring gave way under influence of the frosty weather.

THE Italian Geographical Society (the *Daily News* Roman correspondent telegraphs) held its first monthly meeting of the winter session on Sunday. Capt. Barrattieri read the report of the Society's expedition to the Tunisian Sahara last June. It gave interesting details of the journey to Gabes, to the Island of Gerba, and to other islands, described the country minutely, and proved the impossibility of the French project for connecting the Sahara with the Mediterranean by canal. The next paper, that of Deputy Caperio, on the latest explorations of Lake Victoria, dwelt on the importance of investigating the sources of the Nile between the mountains parallel to the coast and Lake Victoria. This was the task of the Italian expedition.

IN illustration of some remarks in the address of the president, Mr. H. R. Robson, of the Scottish Institution of Engineers and Shipbuilders, the number of the *Transactions* of that Society just published contains a large and carefully executed plate exhibiting a section of the Sub-Wealden bore-hole to the depth of 940 feet.

NO. 166 of the *Notizblatt des Vereins für Erdkunde zu Darmstadt und des Mittelrheinischen geologischen Vereins* contains a detailed *résumé* of the meteorological observations made at Darmstadt during 1874, accompanied with a neat and cleanly constructed diagram showing the daily and monthly results; and also the maximum and minimum temperatures, rainfall, and fog at six stations, during September 1875, in the Grand Duchy of Hesse. Among the many points detailed in the summary for Darmstadt may be noted the dates of the last and the first snow in the course of the year, the last and first frost, the last and first frost-day, mean temperature being 32° or lower; the number of frost-days each month, and of summer-days, temperature being 77°·0, or higher, and the particular days on which thunder and other weather-phenomena occurred. From November to June the ozone was greatly in excess during the night, but during the other months the excess occurred during the day. Among other matters, there is an interesting table of the mortality during September last from various diseases, at thirteen towns in the Grand Duchy. The deaths from diarrhœa alone, which amounted to sixty-two, were a sixth of the whole. This high diarrhœa death-rate, which is three times greater than that of London during the same season, and the unequal manner in which these deaths, as well as deaths from phthisis, convulsions, and brain diseases, are distributed among the thirteen towns, suggest the desirableness of an inquiry into their sanitary conditions.

AT recent meetings of the Executive Committee of the British Pharmaceutical Conference, grants amounting in all to 75*l.*, were made to a number of chemists for the purpose of obtaining material to enable them to carry on scientific researches into the nature and properties of certain substances used in pharmacy.

THE additions to the Zoological Society's Gardens during the past week include a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Demerara, presented by Mrs. Sproston; a Tree Sparrow (*Passer montanus*), two Mountain Linnets (*Linaria flavirostris*), European, purchased; a West African Python (*Python sebæ*) from West Africa, presented by Mr. W. H. Berkeley.

AT the annual meeting on the 4th inst. of the Huddersfield Naturalists' Society, the Secretary read a satisfactory report. The number of members is 134, the finances are in a flourishing condition, and during the past year twenty-two papers have been read.

## ON SOME PROPERTIES OF GALLIUM

IN a communication just made to the French Academy, M. Lecoq de Boisbaudran states that he has succeeded, after considerable labour, in obtaining salts of gallium sufficiently pure to give, in addition to the gallium spectrum, only faint traces of the zinc lines Zn $\alpha$ 144·62 and Zn $\gamma$ 150·05.

After adding a few facts regarding mixtures of gallium and zinc, he proceeds to examine certain reactions of the pure salts.

1. The electric spectrum of chloride of gallium, a little concentrated, is very brilliant. The line 417 is much brighter than the line 404. The author did not observe any other line attributable to gallium; there certainly are none of notable intensity, under the conditions. The colour of the spark in chloride of gallium is a beautiful clear violet.

2. In the gas flame he got only the line Ga $\alpha$ 417, and very faint and fugitive, even with a salt which gave a brilliant electric spectrum.

3. The chloride and the sulphate of Ga are precipitated by $NH_3$, but the precipitate is redissolved, in great part, in an excess of $NH_3$. Taking up with HCl the portion not dissolved by $NH_3$, and recommencing the operation, all the Ga is promptly obtained in ammoniacal solution.

4. An ammoniacal solution of sulphate or chloride of Ga is precipitated in the cold or hot state by an excess of acetic acid. The liquor must be extremely diluted.

5. The chloride and the sulphate of Ga are not precipitated in the cold state by the acid acetate of ammonia, but the reaction takes place on heating.

6. The sulphate of Ga is soluble in a 60 per cent. alcohol solution.

8. A salt was obtained which the author believes to be ammoniaco-gallic alum; though, in default of sufficient quantity, he was unable to analyse it or measure the angles.

9. The alum of Ga is soluble in cold water, but, on heating, the salt is decomposed, and the liquor becomes greatly troubled.

10. This alum is not decomposed in the hot state by water with addition of acetic acid.

11. It crystallises very easily in cubes and octahedra, presenting exactly the aspect of ordinary alum; its solution, evaporated under the microscope, also presents the characteristic changes of known alums.

12. The crystals do not act on polarised light (between two Nicols giving extinction).

13. A small crystal was kept some time under a layer of water, then transferred to a slightly supersaturated solution of alumino-ammoniacal alum; it immediately increased in it, and caused the crystallisation of the liquor.

14. With ammonia in excess, the alum of Ga behaves like the other salts of this metal; a portion of the oxide is precipitated, the other portion remains in solution.

15. The very acid solution of $Ga_2Cl_6$ is precipitated by the yellow prussiate.

16. The ammoniacal solution of sulphate of Ga is decomposed by the voltaic current. Metallic gallium is deposited on the platinum plate serving as negative electrode. The positive electrode is covered, at the same time, with a whitish pellicle, which is easily detached from the platinum, and is insoluble in a large excess of $NH_3$. In a first operation 1·6 mgr. of Ga were deposited in 4h. 30m. on a platinum plate of about 185 square millimetres surface. The surface of the positive electrode was about 877 sq. mm. The battery consisted of five bichromate couples (zincs: 17 cm. × 10 cm.) coupled in tension. The author presented to the Academy a specimen weighing 3·4 mgr.; it was deposited in 5h. 40m. on a surface of about 123 to 124 sq. mm. The positive electrode 877 sq. mm.; the current furnished by ten bichromate elements (as above) coupled in tension.

17. Electrolytic gallium forms a very adherent layer; it is hard; it is polished with difficulty by friction with an agate burnisher. A better polish is obtained by strong compression under the burnisher; the metal thus acquires great brightness, and appears whiter than platinum. When the electric current and the relative dimensions of the electrodes are properly regulated, the gallium presents a beautiful dull surface of silvery white, finely granulated, and interspersed with small brilliant points, which the microscope shows to be crystals.

18. Gallium, deposited on a platinum plate, is not much oxidised during washing in cold or boiling water, nor on being dried in free air raised to about 200°. It decomposes water acidulated with HCl in the cold state, and more rapidly in the hot state, with a brisk liberation of hydrogen.

The salts of Ga which M. Lecoq de Boisbaudran has used in his researches, have been from the blend of Pierrefitte; he has, however, found the new metal in other ores of zinc, and notably in a transparent blend from Santander. He believes Ga will be met with in all blends. The Ga he extracted from the blends comes really from these minerals, and not from metallic zinc.

The author's last researches have confirmed the rarity of gallium in blend. The extreme sensibility of the spectral reaction led him even to over-estimate the quantities obtained. "I do not think I exaggerate," he remarks, "in saying that in my first observation I possessed at the most $\frac{1}{100}$ of a milligramme of the new substance dissolved in a very small drop of liquid. The spectral analysis of so small a quantity of matter would have been impracticable before the considerable reduction I made in the dimensions of the apparatus for obtaining electric spectra, and without using very small sparks.

"If, as I suppose, there is no error as to the nature of my alum of Ga, the existence of this salt fixes the atomicity of the new element, and attributes to its oxide the same chemical function as that of alumina. The oxide of gallium, then, will be written $Ga_2O_3$."

The author, in conclusion, refrains, for the present, from discussing the theoretical considerations raised in a recent note by M. Mendeleeff. Questions of the kind have long interested him; but he thinks it very probable that without the particular method followed in the present research, neither M. Mendeleeff's theories nor his own would soon have led to the discovery of gallium.

## SCIENTIFIC SERIALS

*American Journal of Science and Art*, November.—The original articles in this number are:—On the variation in the strength of a muscle, by F. E. Nipher.—Studies on magnetic distribution, by H. A. Rowland. This, Part I., is on linear distribution, and the scope is indicated by the titles of the sections: 1. Preliminary Remarks; 2. Mathematical Theory; 3. Experimental Methods for Linear Distribution; 4. Iron Rods magnetised by induction; 5. Straight Electro-magnets and permanent Steel Magnets; 6. Miscellaneous Applications.—Œstivation and its terminology, by Asa Gray.—A note in relation to the mass of meteoric iron that fell in Dickson County, Tenn., 1835, by J. L. Smith.—Specific gravity balance, by Roswell Parish. The object of this is to determine the specific gravities of minerals, and other solids heavier than water, without the use of exact weights and without mathematical computation.—A paper on Southern New England, by Prof. Dana.—Iowa county meteor and its meteorites, by N. R. Leonard.—On the post-Pliocene fossils of Sankoty Head, Nantuck Island, by A. E. Verrill. This article, referring to the paper by Desor and Cabot (Geol. Soc. Lond., 1849), purports to correct some matters of detail in that paper, and raises the number of known species from seventeen to sixty, of which a list is given.—In the short articles under "Scientific Intelligence" are:—Arithmetical relations between the atomic weights; Evidence of glacial action on the summit of Mount Washington; Discovery of the horns of an extinct species of ox in Ohio.—The two following reports are noticed: On the geology and resources of the region in the vicinity of the 49th parallel from the Lake of the Woods to the Rocky Mountains; A reconnaissance of the Black Hills of Dakota made in the summer of 1874.—In an appendix Prof. O. C. Marsh contributes a paper on the Odontornithes, or birds with teeth. After recapitulating facts he has already contributed, he gives this classification: — Sub-class, ODONTORNITHES: A. Teeth in sockets; vertebræ biconcave; sternum with keel; wings well developed; order, *Ichthyornithes*. B. Teeth in grooves; vertebræ as in recent birds; sternum without keel; wings rudimentary; order, *Odontolcæ*. There are two plates in illustration of this paper.

*Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie*, Oct. 15.—In the concluding part of his article on the higher atmospheric strata, Dr. Hellmann gives the following results:—(2) Moisture: time of maximum, upper station, 4.30 P.M.; lower station, 5.43 P.M.; time of minimum: upper station, 7·3 A.M; lower station, 7.30 A.M. The daily variation at the upper station is only half that at the lower station. From a table of relative humidity we learn that the air is much moister at the upper station and removed by an almost constant quantity from saturation. In the morning and evening the lower air is the moister, at midday the upper. (3) Wind. Easterly winds were less prevalent at the summit than at the foot of Mount Washington, in the proportion of 1 : 2. It is now well ascertained that the wind at ordinary heights increases in strength daily from early morning till about 2 P.M., and then decreases until about 9 P.M. Herr Hellmann was surprised to discover a variation exactly contrary to this to hold on the summit. In fact, the least velocity occurs about 1 P.M., the greatest after 12 at night; while at the foot the usual variations were followed. Dove explains the generally observed increasing velocity in the morning in our climate by the combined action of a large mass of heated air ascending in the east, and the prevalence of westerly winds. In the evening the heated area would lie westward, the two influences would oppose each other and the wind would decrease in velocity. Similarly the diminution of velocity from early morning to mid-day at great heights may be caused by the overflow westward of the air heated in an area east of the station opposing the prevailing west wind, and the acceleration in the afternoon by the overflow eastward from the heated area now in the west adding itself to the west wind. In agreement with this view is the fact, shown by observations on the Rigi, that velocity in summer is least about mid-day, much greater in the early morning and late evening, and in winter on the contrary, in harmony with the variations at low levels. The greatest observed velocity was ninety-six miles an hour. While this storm blew aloft a calm reigned below. But is it not likely that a current was drawn upwards by it? We have no instruments to register vertical currents. With respect to the relation of temperature to height, clearly it cannot be simply formulated, and will differ according to the altitude at which the daily ascending current flows off laterally. (4) Clouds. There was more cloud and fog at the summit about midday than at other times, and, roughly speaking, the amount of cloud varied inversely as that below during the daytime.

*Memorie della Societa degli Spettroscopisti Italiani*, March, contains a table by Father Secchi, showing the number of protuberances and spots viewed, and the number of days on which observations were made during each revolution of the sun from April 1871 to March 1875, in all forty-two revolutions. The number of protuberances or spots seen during each revolution, divided by the number of days, gives an average for each day; this in 1871 was about 26 for protuberances and 100 for spots, and decreases gradually down to 5·45 for protuberances and 18·8 for spots, in March last. Drawings of the chromosphere for January, February, and March, by Secchi and Tacchini, also accompany this number.

May.—A paper by Prof. Bredichin, on spectroscopic observations of the sun, referring to the relation between spots and prominences, or the latter being the cause of the former. A long series of observations by Prof. Tacchini, from February to June 1873, showing the positions on the sun in which prominences containing magnesium or giving the 1474 line were seen. The maximum number of positions in which magnesium was observed for any one day was sixty, and the same number for the 1874 line.—Prof. Pisati contributes a paper on the theories of electro-static induction.

June.—Prof. Tacchini writes on a method of determining the angles of position of spots and faculæ. In this case the image of the sun is thrown by the eye-piece of the telescope on to a screen on which is a divided circle, with which the image of the sun coincides.—Father Secchi contributes a paper on the solar prominences observed from April 1871 to June 1875. Accompanying this paper are tables showing the number of prominences in each ten degrees of solar latitude, together with their heights and sizes.

July.—A note on the presentation of a medal to Prof. H. Draper by the United States Government for his assistance in preparing for the Transit of Venus.—Observations of the positions in which prominences containing magnesium occurred during July 1873, by Prof. Tacchini.—Drawings of chromosphere during March and April 1874, by Secchi and Tacchini.

August.—A continuation of table by Tacchini, showing positions on sun where prominences containing magnesium occurred during August and September 1873.—Prof. Tacchini writes on observation of the Perseids of last August, in which he gives the mean radiant point as 2h. 50m. and + 53° 8'·6.

*Verhandlungen der k. k. geologischen Reichsanstalt.* Vienna, Sept. 30.—In this number Dr. Schimper describes the geological conditions of the district of Arrho, in Abyssinia, and a curious apparently volcanic phenomenon met with there. The district is a cleft-crossed plain near (and below the level of) the

Red Sea, from which it is separated by a low range of hills. The gentle rains at one part of the year supply sufficient moisture to heat the iron pyrites scattered over the surface of Arrho to a mild glow; the substance is decomposed, lixiviated, and brought into combination with several combustible matters, and eruptions like those of volcanoes take place; slime cones are formed from four to twelve feet in height, from which, as from pipes, issue steam and flame. These generally ephemeral formations consist of mud which is mixed with sulphur and salt, and in the dried cones may be found almost pure sublimated sulphur. The general appearance of the place is like that of pulp boiling in a huge, angular, zig-zag cauldron. The phenomenon continues till increased rains lay the ground under water, after disappearance of which at the end of the rain periods, a hard salt crust, several inches thick, covers the ground.—The trachytes of the island of Cos are described by Dr. Dölter; Dr. Stache gives an account of the eruptive rocks in the Ortler region and the mountain group of the Zwölfer-Spitz in Upper Vintschgau; and Dr. Hörnes, of observations in the district where the Rienz takes its rise.

## SOCIETIES AND ACADEMIES

### London

**Royal Society**, Nov. 25.—On the production of Glycosuria by the effect of oxygenated blood on the liver, by F. W. Pavy, M.D., F.R.S.

The conclusions arrived at are that the amyloid substance found in the liver is a body which tends to accumulate in certain animal structures under the existence of a limited supply of oxygen, and that it is through the liver exceptionally receiving the supply of venous blood it does, that the special condition belonging to it is attributable. It is also shown that the undue transmission of oxygenated blood to that organ at once induces an altered state, which is rendered evident by the production of glycosuria.

On the Structure and Relations of the Alcyonarian *Heliopora cœrulea*, with some account of the anatomy of a species of *Sarcophyton*; notes on the structure of species of the genera *Millepora*, *Pocillopora*, and *Stylaster*, and remarks on the affinities of certain Palæozoic Corals, by H. M. Mozeley, Naturalist on the *Challenger* Expedition.

The title of this paper indicates the nature of its contents. The author has not been able to decide whether *Millepora* is one of the actinozoa or belongs to the hydrozoa as stated by Prof. Agassiz. *Heliopora* is undoubtedly alcyonarian.

**Mathematical Society**, Dec. 9.—Prof. H. J. S. Smith, F.R.S., president, in the chair.—Major J. R. Campbell and Prof. G. M. Minchin were elected members.—Prof. Clifford read a paper on the transformation of elliptic functions, in which he attempted to apply Jacobi's geometrical representation of the addition-theorem in elliptic functions to the theory of their transformation.—Prof. Cayley spoke on a system of algebraical equations connected with Malfatti's problem. The communication was an extension of a paper by the same gentleman in the *Cambridge and Dublin Mathematical Journal*, tom. iv., 1849, pp. 270–275.—The chairman next communicated three short notes: 1. On a problem of Eisenstein's. If $p$ is an uneven prime, the function $4\,\frac{x^p - 1}{x - 1} = Z$ can always be expressed in the form $Y^2 - (-1)^{\frac{1}{2}(p-1)} p X^2$, where $X$ and $Y$ are rational and integral functions of $x$, having integral coefficients. This is a theorem of Gauss. Eisenstein's problem (*Crelle's Journal*, vol. xxvii. p. 83) is "to determine the cases in which the equation $Z = Y^2 - (-1)^{\frac{1}{2}(p-1)} p X^2$ admits of a multiplicity of solutions, and to ascertain the law connecting the various solutions, when there is more than one." The solution of this problem is as follows:—If $[T, U]$ is *any* solution whatever in integral numbers of the equation $T^2 - (-1)^{\frac{1}{2}(p-1)} p U^2 = 4$, and $[X, Y]$ is any one given solution of Gauss's equation, then all the solutions of Gauss's equation are comprised in the formula—

$$\left[\tfrac{1}{2}\left(TX + (-1)^{\frac{p-1}{2}} p UV\right), \tfrac{1}{2}(UX + TY)\right].$$

Thus if $p = 4n + 3$ the equation admits of but one solution (the four solutions $[\pm X, \pm Y]$ being regarded as but one) except in the case $p = 3$, when it admits of three; if $p = 4n + 1$, the equation admits of an infinite number of solutions. That the functions $[\frac{1}{2}(TX + pUY), \frac{1}{2}(UX + TY)]$ are all of them solutions of Gauss's equation is evident; the proof that this formula comprises all the solutions of the equations is less elementary, because it depends on the irreducibility of the function $Z$. There exists a general theory of the representation of rational and integral functions of $x$ by quadratic forms; such representation being, of course, only possible when the given function of $x$ is capable of resolution into two factors by the adjunction of a quadratic surd.—2. On the joint invariants of two conics, or two quadrics. Let $P$ and $Q$ be two conics, and let 1 2 3 be any triangle self-conjugate with regard to $P$. Let also $P_1, P_2, P_3$, be the rectangles of the points 1, 2, 3, with regard to the conic $P$, these rectangles being taken upon transversals measured in any fixed direction; and let $Q_1, Q_2, Q_3$, have similar meanings with regard to the conic $Q$, the direction of the transversals being also fixed. Then the expression $\frac{Q_1}{P_1} + \frac{Q_2}{P_2} + \frac{Q_3}{P_3}$ has the same value for all self-conjugate triangles of $P$; and is, in fact, that invariant of $P, Q$, which is linear with regard to $Q$, and quadratic with regard to $P$, and the evanescence of which expresses that $Q$ harmonically circumscribes $P$. The corresponding theorem in the geometry of the straight line is: "If $Q_1, Q_2, P_1, P_2$, are two pairs of fixed points on a line, and if $A_1, A_2$, is any pair of harmonic conjugates of $P_1\,P_2$, the value of the expression

$$\frac{A_1Q_1 \cdot A_1Q_2}{A_1P_1 \cdot A_1P_2} + \frac{A_2Q_1 \cdot A_2Q_2}{A_2P_1 \cdot A_2P_2}$$

is independent of the particular pair $A_1\,A_2$ considered." From this theorem, the result given above for two conics follows immediately; from it the corresponding property for two quadrics may be inferred, viz.:

$$\frac{Q_1}{P_1} + \frac{Q_2}{P_2} + \frac{Q_3}{P_3} + \frac{Q_4}{P_4} = \text{constant};$$

and so on for quadratic functions containing any number of indeterminates. 3. On the equation $P \times D =$ constant, of the geodesic lines of an ellipsoid. From this equation (in which $P$ is the perpendicular from the centre upon the tangent plane at any point of the geodesic, and $D$ is the semi-diameter parallel to the tangent line of the geodesic) it is convenient to be able to infer directly the principal properties of the geodesic line, without having first to transform the equation into M. Liouville's form, $\mu^2 \cos^2 i + \nu^2 \sin^2 i = a^2$. In Dr. Salmon's "Geometry of Three Dimensions," the theorem of the constancy of the sum or difference of the geodesic radii vectores, drawn from any point of a line of curvature to two umbilics, is thus demonstrated. And it is worth while to add (though it is very improbable that the point has not been noticed before) that a proof of the theorem that two geodesic tangents of a line of curvature which intersect at right angles, intersect on a sphero-conic, may similarly be obtained without transforming the equation. Let $Q$ be the point where the two geodesic tangents intersect at right angles, $O$ the centre of the ellipsoid; let $c = OQ$, and let $a, b$ be the semi-axes of the central section parallel to the tangent plane at $Q$. The two geodesics make angles of 45° with the lines of curvature at $Q$: hence, for either of these geodesic lines, $D^2 = \frac{2a^2b^2}{a^2 + b^2}$. Let $Q'$ be a second point where two geodesic tangents to the same line of curvature intersect at right angles; then $\frac{2P^2a^2b^2}{a^2 + b^2} = \frac{2P'^2a'^2b'^2}{a'^2 + b'^2}$, because $P \times D$ has the same value for all geodesic lines touching the same line of curvature. But $P^2a^2b^2 = P'^2a'^2b'^2$, because parallelepipeds circumscribing an ellipsoid with their faces parallel to conjugate diametral planes are equal. Hence $a^2 + b^2 = a'^2 + b'^2$. But also $a^2 + b^2 + c^2 = a'^2 + b'^2 + c'^2 \therefore c = c'$, and $Q$ and $Q'$ lie in the same sphero-conic. Mr. Tucker (in the absence of the author) brought before the Society a paper by Mr. H. W. Lloyd Tanner on the solution of certain partial differential equations of the second order, having more than two independent variables. The equations considered are included in the form—

$$\sum_{i=1}^{i=n} \sum_{j=1}^{j=n} V_{ij} \frac{d^2z}{dx_i dx_j} + V_0 = 0 \quad . \quad . \quad . \quad (1)$$

where $V_{ij}\,V_0$ are functions of

$$x_1 \ldots x_n, z, p_1\left(\equiv \frac{dz}{dx_1}\right) \ldots p_n\left(\equiv \frac{dz}{dx_n}\right),$$

and it is proposed to investigate the conditions that (1) should be soluble in terms of arbitrary functions, the arguments of

which are definite functions of $z, x_1 \ldots x_n$; and when these conditions are satisfied to determine the solution. Three cases arise for discussion: (1) $n - 1$ of the arguments independent, (2) $n$ of them independent, (3) $n + 1$ of them independent. The paper concludes with a note on the application of a similar method to equations of an order higher than the second.

**Zoological Society**, Dec. 7.—Mr. George Busk, F.R.S., V.P., in the Chair.—Mr. Sclater read an extract from a letter addressed to him by Mr. H. A. Wickham, on the occurrence of the large blue Hyacinth Macaw, (*Ara hyacinthina*) near Santarem, on the river Amazons.—Mr. Sclater exhibited and made remarks on a Skin of *Hypocolius ampelinus.*, Bp, obtained by Mr. W. T. Blanford, in Upper Scinde, to the west of Shikaprur.—Prof. Owen, C.B., read the twenty-second part of his series of Memoirs on Dinornis. This part contained a restoration of the skeleton of *Dinornis maximus.*—Mr. J. W. Clark read a paper on the Eared Seals of the islands of St. Paul and Amsterdam, to which he added a description of the Fur Seal of New Zealand from specimens kindly furnished by Dr. Hector. Mr. Clark further read copious extracts from the narratives of the older Explorers in these seas, and attempted to reconcile the notices given by them with the subsequent description of Naturalists.—A communication was read from the Rev. R. Boog Watson, on the generic peculiarities of the distinctively Madeiran Achatinas of Lowe.—A communication was read from Dr. Hermann Burmeister, Director of the National Museum, Buenos Ayres, containing the description of a new species of *Dolichotis*—which Dr. Burmeister proposed to call *Dolichotis salinicola.*—Mr. W. T. Blanford communicated particulars respecting some large Stags' Horns, obtained by the Expedition to Western Turkestan to which the late Dr. Stoliczka was attached as Naturalist, said to have been brought originally from the Thian Shan Mountains. These horns were of very large size, each measuring 51 inches in length round the curve. Mr. Blanford, considering that these horns clearly showed the existence of a species hitherto undescribed, gave a full description of them, and proposed to give the name of *Cervus eustephanus* to the animal to which they belong.—Dr. O. Finsch communicated some notes on *Phœnicomanes iora*, Sharp, and *Abrornis atricapilla*, Blyth, and pointed out that the first named bird is identical with *Iora lafresnayei* of Malacca, while *Abrornis atricapilla*, said to be from China, is in fact a *Myiodioctes pusillus*, Wils., a well known North American bird.—A second communication from Dr. Finsch contained the description of a bird from the Arfak Mountains, New Guinea, which appears to form a new genus and species. This Dr. Finsch proposed to call *Pristornamphus versteri.*—A third communication from Dr. Finsch gave the characters of six new Polynesian birds in the Museum Godeffroy at Hamburg.—A communication from Mr. J. Caldwell, contained some notes on the Zoology of the Island of Rodriguez.—Dr. E. Von Martens communicated a list of the Land and Fresh Water Shells collected by Mr. Osbert Salvin in Guatemala in 1873-74.

**Geological Society**, Dec. 1.—Mr. John Evans, V.P.R.S., president, in the chair.—M. Rodolfo de Arteaga, William Henry Barnard, the Rev. J. Clifford, M.A., Lieut.-Gen. Robert Fitzgerald Copland-Crawford, R.A., Walter Derham, B.A., James Duigan, George R. Godson, the Rev. Algernon Sydney Grenfell, Sir David Salomons, Bart., Aubrey Strahan, B.A., William Thomas, Edward Wethered, F.C.S., the Rev. Burgess Wilkinson, and Edward Alfred Wünsch were elected Fellows of the Society. The following communication was read:—On the granitic, granitoid, and associated metamorphic rocks of the lake-district.—Parts III., IV., and V., by Mr. J. Clifton Ward, of the Geological Survey of England and Wales. Part III. On the skiddaw granite and its associated metamorphic rocks. The subject was treated under the three heads of (1) Examination in the field, (2) Microscopical examination, (3) Chemical examination, and the following were the general results arrived at. The metamorphism of the skiddaw slate extends for many miles around the several granitic masses, and commences by the formation of small spots which become developed into chiastolite crystals. The chiastolite *slate* passes into spotted *schist*, by the great increase of the small oblong spots arranged along planes of foliation, and mica appears. The spotted schist graduates into mica-schist, which, however, often retains to the last faint spots, and occasionally chiastolite crystals. The junction between the mica-schist and the granite is generally rather abrupt. On the whole, chemical and field evidence especially are *against* regarding the granite, now exposed, as the result of the extreme metamorphism of the skiddaw slates *immediately* around it; but whether it may not have resulted from the metamorphism of underlying parts of the same series is an open question. The great contortion of the mica schist around the granitic centres may be in part due to the, at any rate, *partially* intrusive character of the granite. In an appendix abstracts of papers by various authors who have written in connection with the subject were given.—Part IV. On the quartz felsite, syenitic, and associated metamorphic rocks of the lake district. This part was treated under the same three heads of field, microscopical, and chemical evidence as the last. The quartz felsite of St. John's Vale, and the syenitic granite of Buttermere and Ennerdale, lie for the most part at the junction of the volcanic and skiddaw series, and seem by their line of strike, and by the occasional presence of bands of slate or volcanic rock enclosed within or running through them, to represent the transition beds between the two series, metamorphosed in great measure *in situ*. Both microscopic and chemical evidence demonstrate the possibility of this process. Evidence gathered in the field, and microscopic and chemical examination, all seem to suggest that the rocks of Carrock Fell, &c., represent the base of the volcanic series, consisting largely of contemporaneous traps, thrown into a synclinal, the axis of which ranges generally east and west, and metamorphosed into rocks of greatly varying character, such as sphærolitic felsite, hypersthenite, and diorite. Although all the various masses treated of were probably formed in the main by the metamorphism of beds *in situ*, it is probable that some parts of the resulting magma became occasionally intrusive among and absorptive of higher beds. In an appendix notices of papers on these rocks by other authors were given.—Part V. General summary. In this part the leading results of the four preceding divisions of this memoir were briefly brought forward, followed by the discussion of various considerations relating to metamorphism, under the following heads:—1. Granite at various depths; 2. How far granite may be an ultimate universal product of metamorphism; 3. Distribution of metamorphism (selective metamorphism); 4. Classes of metamorphism. The paper was illustrated by a large geological map of the northern part of the Lake district, by a geological model of the Keswick district, by rock specimens, and large coloured photographs taken from water-colour microscopic drawings made by the author.

**Physical Society**, Dec. 11.—Prof. Gladstone, F.R.S., president, in the chair.—The following candidates were elected members of the Society:—C. Higgins and S. O. Thompson, B.A., B.Sc.—In the absence of Prof. G. C. Foster, Mr. Lodge exhibited and described a simple form of chronoscope for measuring short intervals of time, which Prof. Foster has recently devised. In experiments commenced about eight years ago the apparatus consisted essentially of three parts: 1. An arrangement for releasing the bullet or other body whose fall was to be timed, when the apparatus is employed for such determinations; 2. An arrangement for directing a gauged stream of water into a vessel during the time occupied by the fall of the body; and 3. A platform to receive the falling body. The stream of water was directed into the vessel by means of a bent funnel brought under a constantly flowing stream by an electro-magnet. But this apparatus had two serious defects, one of which was caused by the difficulty of accurately gauging the stream, and the other by the inertia and consequent sluggishness of movement of the funnel. The arrangements, however, for dropping and receiving the bullet being satisfactory, were finally adopted. The former is simply a clip one side of which is a spring, and this forms the armature of a small electro-magnet. On completing the circuit the spring is drawn aside and the bullet released, momentarily breaking a current which passes through it, as subsequently described. The bullet, at the end of its fall, strikes a small mahogany table, so arranged that the blow slightly depresses it, and permanently breaks the same current, which in the interval has been closed by a subsidiary wire. The author abandoned the method of indicating the commencement and end of the fall by an independent electro-magnet and, substituting the trace made on blackened paper by a vibrating tuning-fork for the stream of water, he registered them by perforations made by induction-coil sparks in the blackened paper, a method suggested by the description of Beetz chronoscope. The apparatus is difficult to describe without the aid of diagrams, but the following will perhaps sufficiently indicate the general arrangement. The two terminals of the secondary coil are connected, the one with the tuning-fork, and the other with the metallic drum on which the blackened

paper is carried. The other connections are as follows:—The current passes from one pole of battery to spring of releasing apparatus (which is also connected with one terminal of a separate condenser), thence through the bullet to the fixed portion of the clip, and by a wire to the lower table, which is also in electrical connection with the face of the electro-magnet which releases the bullet, in order that the current may be completed immediately the falling body is released. From this table the current passes through an adjusting screw to one terminal of the primary wire of the induction coil which is connected with the other condenser terminal. The other pole of the battery is connected with the primary. The spark in each case is caused by the breaking of the current which takes place when the bullet is released and when it strikes the table, the perforations in the black paper of course being made in the trace produced by the tuning-fork. It is hardly necessary to mention that the releasing electro-magnet is worked by one or two independent cells. The author considers that with a fork making sixty-four complete vibrations in a second the error, in determining an interval of not more than two or three seconds, should not exceed $\frac{1}{500}$th of a second, and that with a more rapidly vibrating fork probably much greater accuracy might be attained. Mr. Lodge made four experiments before the Society with falls of 2 ft. and 1 ft., from which the value of gravity was found to be 32·21. Prof. Guthrie inquired whether the instrument was sensitive to the influence of temperature on the time of vibration of the tuning-fork. Mr. Ladd suggested that the pressure of the marker on the end of the tuning-fork might hinder its vibration, and referred to difficulties which Capt. Noble had met with in the working of his chronograph. Mr. Lodge stated that experiments had only been made in a laboratory having a fairly equable temperature, and that therefore the effect of considerable changes of temperature had not been ascertained. He considered that the slight resistance referred to by Mr. Ladd would rather tend to diminish the amplitude of vibrations than to change their number per second.—Prof. McLeod then described and exhibited an arrangement for ensuring that the charge given to a Leyden jar shall not exceed any fixed limit. Through a cork in the upper end of a bell-glass passes a brass rod, insulated through its entire length by means of a glass tube, through which it passes freely. To the upper end is attached a brass knob, and the lower end is pointed and provided with a screw-thread, so that it can be set at any distance within, or through, a hollow brass ball, perforated below and rigidly fixed to the glass tube. Within the bell-glass is a loose cage of perforated sheet zinc and a vessel containing strong sulphuric acid. The whole stands on a metallic plate to secure a good earth connection. The action is as follows:—If the rod be screwed down so that the point projects through the hollow ball, the upper knob and lower metallic plate being connected with the two poles of a Holtz machine, only short sparks can be obtained, because a large amount of electricity escapes at the point; but if the rod be raised so that the rod barely enters the hollow ball, at the top, no escape takes place from it, and the machine will give its full length of spark. By varying the position between these two extreme limits, any required length of spark or amount of charge for an interposed Leyden jar can be obtained.

**Entomological Society**, Dec. 1.—Sir Sidney Smith Saunders, C.M.G., president, in the chair.—Mr. W. A. Forbes exhibited a variety of the Burnet Moth (*Zygæna filipendula*), with yellow spots, of which he had bred a number from larvæ taken near Winchester.—Mr. Champion exhibited some rare British Coleoptera.—Mr. William Cole exhibited carefully-executed drawings of the pupæ of a species of the Dipterous genus *Ephydra*, which he had taken clinging to the stems of grass, in brackish water, near Southend, Essex.—The President referred to the numerous parasites found on bees of the genus *Osmia*, and remarked that M. Jules Lichtenstein had recently obtained *Zonitis præusta* from the cells of *Osmia tridentata*; and likewise *Euchalus vetusta*, Duf., from its desiccated adult larvæ, in the same way that *Halticella osmicida* effects its metamorphosis, thus making the thirteenth parasite recorded as infesting this particular species of bee.—A paper was communicated by Dr. Burmeister, of Buenos Ayres, giving a description of a new genus belonging to the family *Scaritidæ* (nearly allied to *Clivina*), taken on the shore of the river Uruguay, near the town of Concordia.

### Paris

**Academy of Sciences**, Dec. 6.—M. Frémy in the chair.—On the constitution of phosphates, by MM. Berthelot and Louguinine.—Atmospheric perturbations of the hot season of 1875, by M. Belgrand.—On the colouring matter of fruits of Mahonia, and the characters of the wine these fruits give by fermentation, by M. Is. Pierre.—On the astronomical phenomena observed in 1597 by the Dutch in Novaya Zemlya, by M. Baills.—Note on the double touch process of magnetisation, by M. Gaugain.—On the temperature of elevated layers of the atmosphere, by M. Mendeleeff. The temperatures observed there are constantly higher than those calculated; this is accounted for by aqueous vapour.—On the transparence of flames and of the atmosphere, and on the visibility of scintillating lights, by M. Allard. From experiment he adopts 0·81 as mean value of the coefficient of transparence of flame, referred to the centimetre of thickness traversed. The absolute intensity of flame increases more rapidly than the weight of oil consumed, but the amount of light absorbed in passage of rays through the flame increases still more rapidly.—On the distribution of magnetism in circular or elliptical steel plates, by M. Duter.—On some properties of gallium, by M. Lecoq de Boisbaudran. This is noticed fully elsewhere.—Note on a derivative by hydratation of cellulose, by M. Aimé Gerard.—Researches on the constitution of albuminoid matters, by M. Schutzenberger.—On the development of the fruit of *Chaetomium*, and the supposed sexuality of Ascomycetes, by M. van Tieghem.—On new fossil pieces discovered in the phosphorites of Quercy, by M. Gaudry.—On the virulent state of blood of healthy horses, killed by falling or asphyxia, by M Signol. The blood taken from the body after sixteen hours proves rapidly fatal to goats or sheep inoculated with it (twenty-four drops). Motionless bacteridia are present, but there is no sign of putridity.—Discovery of the 157th small planet at Marseilles on Dec. 1. Ephemerides and observations of planets lately discovered, by M. Stephan.—Observations of planets (152) and (154) made at the Paris Observatory, by M. Prosper Henry.—On the isochronism of the spirals of chronometers, by M. Caspari.—Note on the distribution of magnetism in the interior of magnets, by MM. Trève and Durassier.—On the fermentation of fruits, by MM. Lechartier and Bellamy.—On panification in the United States, and the properties of hops as ferment, by M. Sacc.—On the presence, in present seas, of a type of Sarcodaria of the secondary strata, by M. Fischer.—On larval forms of Bryozoa, by M. Barrois.—On the organisation of Acarians of the family of Gamasides; characters showing that they form a natural transition between hexapodan insects and Arachnida, by M. Megnin.—Nidification of the rainbow fish of India, by M. Carbonnier.—On the ferns and Lycopodiaceæ of the islands St. Paul and Amsterdam, by M. Fournier.—On the influence of stripping off the leaves of beet on production of sugar, by M. Corenwinder.

## BOOKS AND PAMPHLETS RECEIVED

BRITISH.—The Native Races of the Pacific States of North America. Vol. iv.: Hubert Howe Bancroft (Longmans).—The Movements and Habits of Climbing Plants: Charles Darwin, M.A., F.R.S (Murray).—Medicinal Plants. Part 2: R. Bentley, F.L.S., and H. Trimen, M.B., F.L.S. (Churchill).—Milk in Health and Disease: A. Hutchinson Smee (Newman).—Magnetism and Electricity: F. Guthrie (Wm. Collins, Sons and Co.)—Hermann's Human Physiology. Translated by A. Gamgee, M.D., F.R.S. (Smith and Elder).—Pyrology, or Fire Chemistry: Wm. A. Ross (Spon).—Timber and Timber Trees: Thomas Laslett (Macmillan).—Discoveries and Inventions of the Nineteenth Century: R. Routledge, B.Sc., F.C.S. (Routledge).

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